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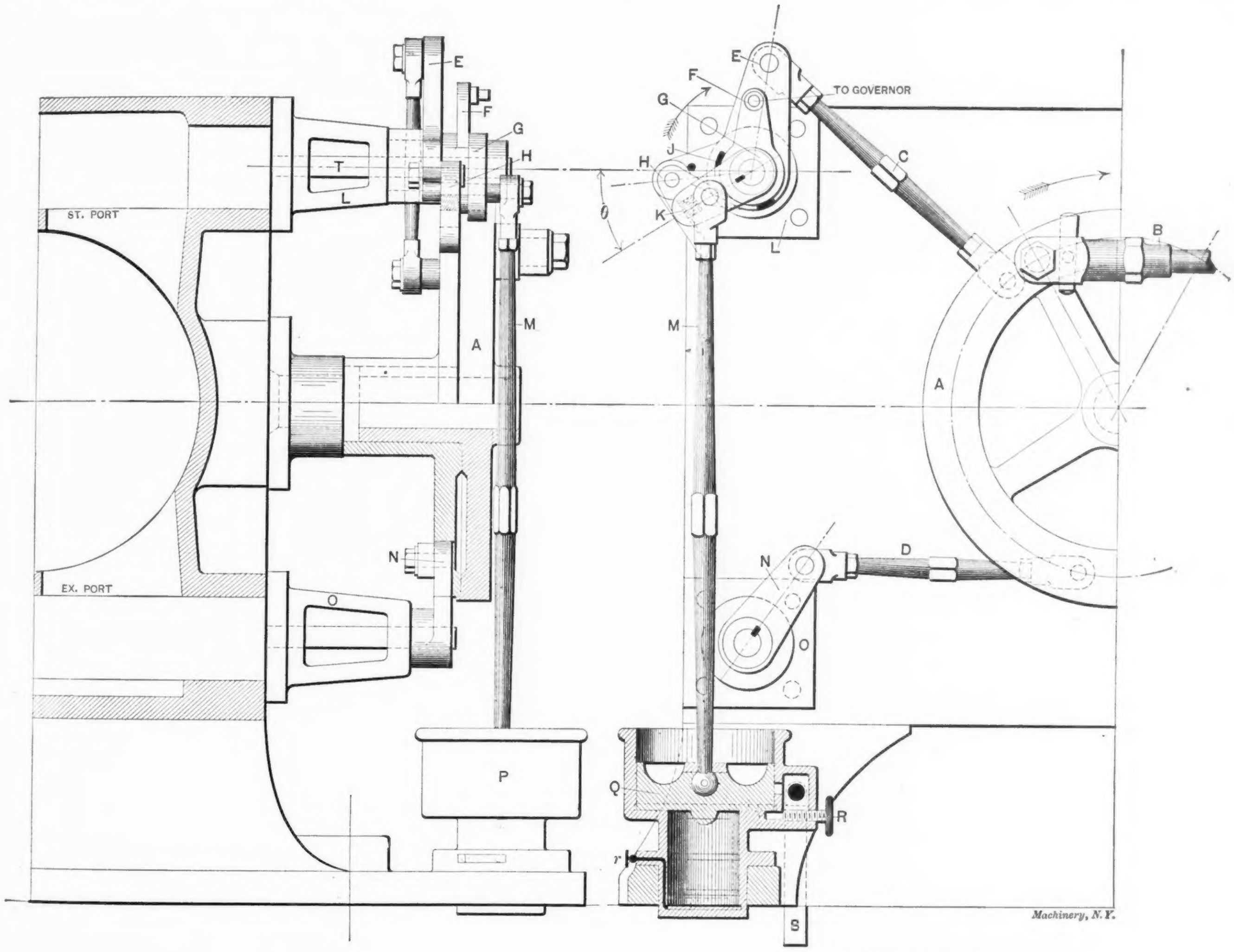
THE CORLISS ENGINE.—1.

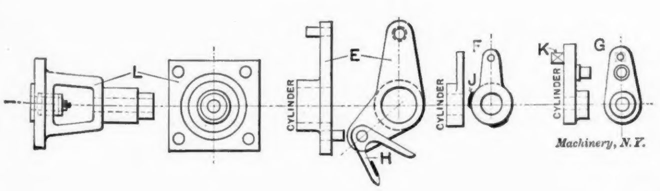
A DESCRIPTION OF THE REYNOLDS-CORLISS VALVE MOTION; ALSO A DRAWING-ROOM METHOD FOR THE DESIGN OF THE SAME.

A. H. Eldredge.

While there are many different Corliss valve gears, there is none more extensively used, or better known, than the one invented by Mr. Edward Reynolds, and known among Corliss valve gears as the "Reynolds Hook Motion."

To many engineers few valve motions appear more complicated and difficult to understand. A little study will, however, disclose the fact that the Corliss valve gear is one easy to be designed, adjusted and operated, and easy to be understood.





NOMENCLATURE OF VALVE GEAR.

A...Wrist Plate.
B...Hook Rod.
C...Steam Rod.
D..Exhaust Rod.
E...Bell Crank Arm.
F...Knock-off Arm.
G...Steam Arm.
H..Steam Hook.
J...Knock-off Clip.
K..Steam or Hook Pin.
L..Steam Bracket.
M..Dash-Pot Rod.
N...Exhaust Arm.
O.. " Bracket.
P...Dash-Pot.
Q.. " " Plunger.
R.. " " Air Valve.
r... " " Release Valve.
S... " " Air Pipe.
T...Steam Valve Stem.

FIG. I.

That the subject may be presented as clearly as possible, the names of the various part are given in connection with Fig. I, which, with a brief description of the function of the parts, should present the matter clearly.

Referring to Fig. I, let us start with the wrist plate at its extreme travel to the left, and just beginning to move toward the right, as indicated by the arrow. Then the bell crank arm (E) will move in the same direction, and will carry with it the steam hook (H), which will latch with the square hook pin (K) on the steam arm (G), causing the steam arm to rotate in the direction of the arrow. The steam-arm is keyed to the valve stem, which in turn has a fixed connection with the valve, so that, as the steam arm raises, it carries with it the steam valve and opens the steam port. At the same time the steam arm raises the dash-pot plunger (Q). The steam arm will be carried by the steam hook until the inner leg of the hook strikes the knock-off clip (J), when the hook will be forced away from the hook pin (K), releasing the pin and allowing the dash-pot plunger to fall. The dash-pot plunger will carry with it the steam arm and the steam valve, and will, in its descent, close the steam port almost instantly.

This releasing of the steam valve and its almost instant closing

of the steam port is what constitutes the distinctive feature of the Corliss detachable valve gear, commonly known as the "drop cut-off."

The position of the knock-off lever (F) is controlled by the governor, and changes with the load of the engine. The exhaust valves are positive in their action, and have fixed points of release and compression.

The working of the dash-pot will be explained further, as it is frequently misunderstood. Its office is to close the steam valve the moment the steam hook releases the steam arm, cutting off instantly the supply of steam to the cylinder. Here is where the great economy of the Corliss over many other engines is effected. The advantage of such a cut-off can be shown by Fig. II. Let (A) be a slide valve, (B) a steam port, and (C) an eccentric for driving the valve. Now, it is evident that if (C) opens the port while moving from (m) to (n), it will require the same

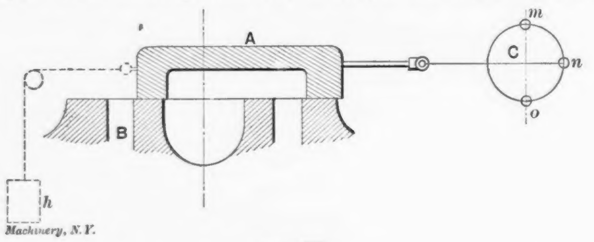


FIG. II.

length of time to close it, or while the eccentric moves from (n) to (o). If, now, when the eccentric is at (n) we could disconnect it instantly from the valve and allow a weight (h) to close the valve, we would have a much quicker closing, and we would therefore get more work out of the expansion of the steam. That is just what occurs in the Corliss engine, and is the reason for using the dash-pot. The dash-pot consists of a cylinder closed at one end and containing a closely fitting plunger (Q), Fig. I. The cylinder and plunger have two diameters, as shown.

Connected with the upper chamber is an air pipe (S), also an air valve (R), while a small release valve (r) is connected with the lower portion of the dash-pot. Its working is as follows:

When the plunger is in its lowest position, it fills the bottom of the pot completely, thus expelling all air. As the plunger rises, if there be no connection to the atmosphere, a vacuum will be formed under the plunger. This is what occurs in the lower portion of the pot, while the air is allowed to flow freely into the upper portion of the pot through pipe (S).

On the down stroke of the plunger we will have the force of gravity acting on the weight of the plunger, plus the atmospheric pressure over an area equal to that of the small diameter of the plunger, due whatever vacuum may have been formed as the plunger rose. At the same time the air will escape freely from the upper part of the pot through pipe (S) until the plunger cuts off that connection when the valve (R) will throttle the escape of the remaining air, bringing the moving parts to rest quietly. The small valve (r) is to allow the plunger on its descent to force out any air that may have leaked into the lower chamber of the dash-pot.

DESIGN OF THE CORLISS VALVE GEAR.

As has been stated, the Corliss valve gear is a comparatively easy valve motion to design, the reason being that one valve does not have to control the entire steam distribution of the engine. There being separate steam and exhaust valves at each end of the cylinder, it is a comparatively easy matter to adjust for the different events of the stroke with each valve separately. Again, the cut-off is independent of the eccentric motion, which simplifies matters.

The method of design to be presented is a drawing-room method that has often been used for this work. The principle points to be considered are:

1st. A quick and sufficient port opening to insure boiler pressure to cut-off.

2d. Ample movement of the exhaust valves to insure a free exhaust.

3d. Proper closing of the exhaust valves for necessary compression.

The first thing to be done is to determine the size and dimensions of the port openings in the cylinder. These can be figured if we know the size of the cylinder and the piston speed from the formula,

$$\text{Area of port} = \frac{A.\ S.}{N} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{I.}$$

A = area of cylinder in inches,
S = piston speed in feet per minute,
N = 10,000 for the steam port,
N = 6,000 for the exhaust steam.

As an example: Required, the area of the steam port of an engine having a cylinder 24 inches in diameter and 48 inches stroke, making 85 revolutions per minute.

$$\text{From I. Area} = \frac{452.4 \times 8 \times 85}{10{,}000} = 30.8 \text{ sq. in.}$$

In a 24-inch cylinder the port would be about 21 inches long and the width of the port would be $30.8 \div 21 = 1.4$ inches. In practice we would, in such a case, use a port 21 inches by $1\frac{1}{2}$ inches.

Having determined the port openings of the cylinder, we should next draw the center lines of the cylinder and ports as shown at aa', bb', cc' and dd', Fig. III. The cylinder should be long enough so that, after allowing for the thickness of the piston, the ports can enter the cylinder at right angles to its center line. The exhaust ports should be vertical and symmetrical about the center line, passing through the port, as shown at (S), Fig. III. This obviates right and left-hand castings and simplifies matters greatly in the machine shop, as well as when repairs are required. When the exhaust port is made, as at (S), Fig. III, the valve will take up its own wear, as it lies directly over the port when closed, thus insuring a tight port, while it is impossible to get the valve in upside down and cause the destruction of an engine.

With a valve and ports as shown at (R), Fig. III., there is nothing to prevent the steam leaking around the valve on the least wear of valve or port. An examination of any Corliss engine will show that the wear of the exhaust valves always comes on the bottom of the port.

The width of the steam port having been determined, we can find the travel of the valve. Having the travel of the valve, we can get the angle of motion of the steam and bell crank arms.

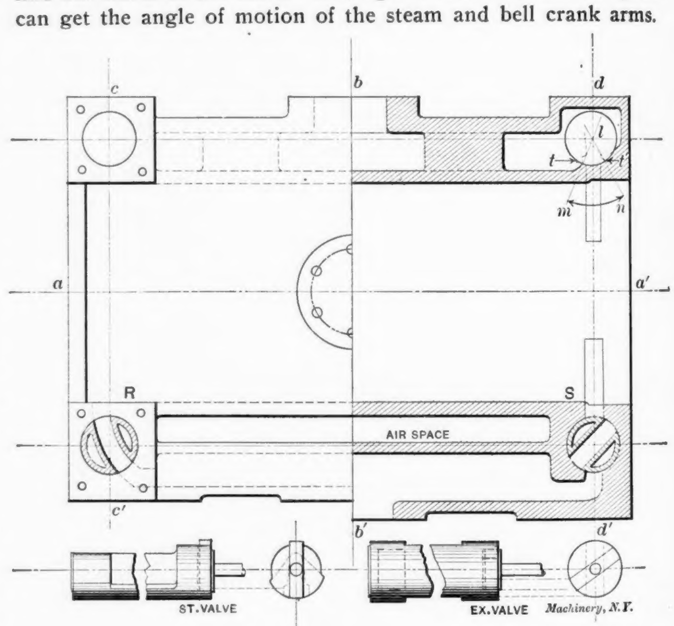


FIG. III.

If the length of these arms is determined we can get the size and angle of motion of the wrist-plate and so on, until the throw of the eccentric is determined.

The travel of the valve will equal,

Valve-travel = the width of steam port + the lap of the valve when the dash-pot plunger is down + over travel............II.

The lap of the valve will, in this case, vary from $\frac{1}{4}$ inch to $\frac{3}{8}$ inch, and should be sufficient to insure a tight port when closed.

Note.—The lap of the valve as given above is not the lap of the valve in the ordinary sense of the term. Ordinarily the lap of the valve is "the amount of valves covers the port, with the valve gear in its central position." When two eccentrics are used the real lap would be a negative amount. In other words, the steam port would be open when the valve gear was in its central position, and because of this fact the range of cut-off would be in-

creased from about 33 per cent. to 75 cent. or over. That is the reason for using separate steam and exhaust eccentrics, as is frequently done in Corliss engine practice of to-day, especially in engines having a widely-varying load, as for street car service.

The over-travel in Rule II. is for the sake of more rapid valve opening at the beginning of the stroke; the extra work and wear due to the over-travel being inappreciable, while the gain in rapid port opening is considerable. An over-travel of from 3-16 inch to 5-16 inch, depending on the size of the engine, is about what is usually allowed. A sketch of the valve, traced to scale on tracing cloth, that can be used in connection with the drawing on the drawing board, will be found useful.

In designing the various valve arms, it will be found that considerable leeway can be used as to their lengths, as well as in the various angles between them, when the wrist plate is in its central position. The shorter these arms the less will be the eccentric throw for a given valve travel, and vice-versa. The minimum lengths of these arms will be fixed by the striking points of the various parts, as determined by their construction. The young designer should follow standard practice in this matter.

On the drawing, next lay off at point (t), Fig. III., the amount the valve covers the port when unhooked, and at (t') lay off the over-travel. Then the maximum travel of the valve will be (tt'). Now put a pin through the center of the valve-model and the port, and by turning the valve from (t) to (t') we can see the positions that will be assumed by the valve in its extreme travel. We will thus have the angle (m l n) through which the valve moves. The angles through which the steam and bell crank arms move will be only enough greater to allow 1-32 inch clearance for the hook to latch with the hook pin. The angle, Fig. I., will approximate 30 degrees to 35 degrees when the valve gear is in its lowest position. The point to be considered here is, not to work the steam hook through a bad angle, for if it is raised too high it will release the hook pin before time for cut-off to occur.

In the next article the wrist-plate and its connections will be taken up; also a table of some of the principal dimensions relating to the valve gear on engines of various sizes.

* * *

LEVERS.—3.

THE CALCULATION OF COMPOUND LEVERS.

It often happens that it is necessary to use two or more levers connected one to the other in a series, where it would not be convenient to obtain the desired multiplication with a single lever, or where it is necessary to distribute the forces acting. In such cases the levers are called compound levers and their application is found in testing machines, car brakes, printings presses and many other machines and devices. Probably the most familiar example is that of a pair of scales, and we will take this to illustrate the method of making the calculations for compound levers.

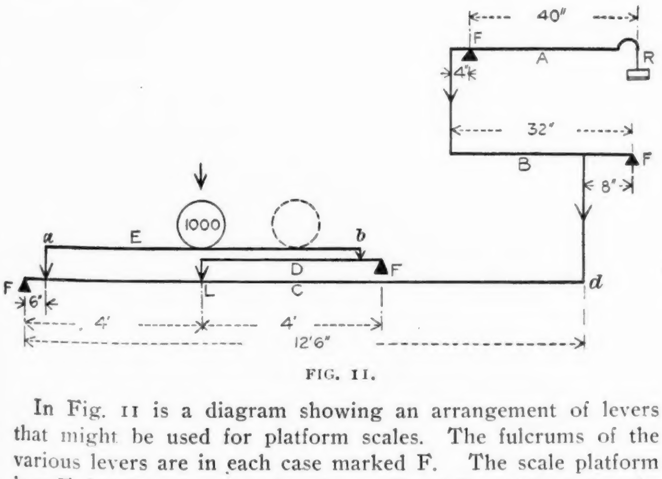


FIG. 11.

In Fig. 11 is a diagram showing an arrangement of levers that might be used for platform scales. The fulcrums of the various levers are in each case marked F. The scale platform is at E, bearing at each end on levers C and D, and loaded at the center with 1,000 pounds. A pressure of 500 pounds, therefore, is transmitted to lever C at a point 6 inches from the fulcrum and 500 to lever D. As lever D is proportioned exactly the same as that part of lever C to the left of the center line of the weight; that is, as the distance from F to L in each case is exactly 4 feet, and the short arms are each 6 inches long, it follows that the final effect is the same as though the whole 1,000 pounds acted at a point 6 inches from the fulcrum F of the lever C.

Continuing through the various connections, the right-hand end of C pulls down on the lever B at a point 8 inches from its fulcrum, and this in turn pulls down on the scale beam A at a

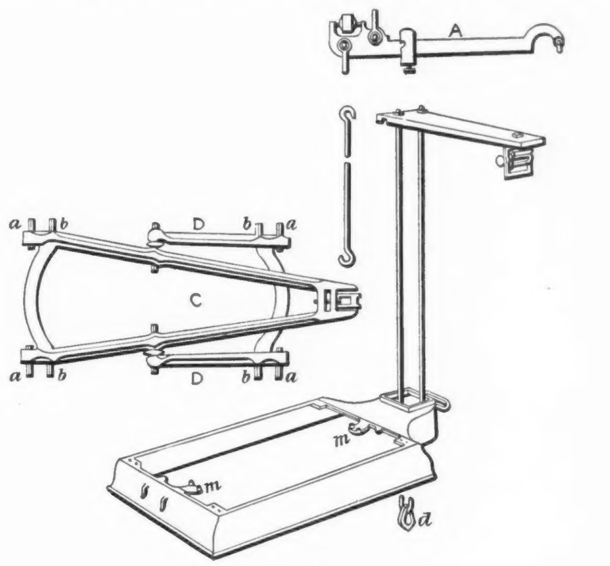


FIG. 12.

point 4 inches to the left of its fulcrum and lifts the weight R. Question: What weight at R is required to balance the 1,000 pounds on the platform, assuming that the system of levers is in balance so that there is no unbalanced weight to be considered? This is always provided for by a counterpoise on the scale beam.

The best way to solve any example of compound levers is to first determine the number of multiplications of each lever. Lever A has arms 40 and 4 inches long, and multiplies 10 times; lever B multiplies 4 times; and lever C 25 times. Each lever multiplies in the same direction; that is, it tends to increase the force acting when we start at point R. Hence, the total multiplication is $10 \times 4 \times 25 = 1,000$, and one pound at R would balance the 1,000 pounds on the platform.

It may be asked whether with this arrangement the weighing of the scale would not be altered should the weight be moved to the dotted position shown in Fig. 11. A little thought will show that it would not. We have seen that the reduction from both points a and b to point d is 25 to 1, and it can make no difference whether 500 pounds acts at both a and b or whether, for example, 300 pounds acts at a and 700 at b, the total 1,000 pounds being reduced 25 to 1 in either case.

It will be interesting in this connection to note the actual arrangement of the levers in a pair of scales. Fig. 12 is made from a blueprint of the Fairbanks portable scale, kindly furnished by Mr. W. H. Sargent, a frequent contributor to MACHINERY. The frame of the scale appears with part of the casing removed. The levers A, C and D are lettered the same as the corresponding levers in Fig. 11, there being in this case no intermediate lever B. Staples like d, Fig. 12, fit in the corners of the base and support the knife edges a, a, a, a, of levers C and D. Knife edges b, b, b, b carry the platform and projections m, m, of the base are for attaching links that keep the platform from having too great a side or endwise motion.

Before closing it may be well to show how to graduate a scale beam. It is occasionally necessary to graduate beams for dynamometers or for special weighing or testing devices met with in regular engineering work.

In Fig. 13 is a scale beam of regular pattern, with fulcrum at F, the scale pan at R, the rod connecting with the platform at P and the sliding weight r. The counterpoise C is for the purpose of balancing the arm when there is no weight either on the scale platform or the pan, and when the weight r is at the zero mark.

We will assume, as is the usual custom with scale beams of all descriptions, that when the weight is at the outer end of the arm at a, it is to have the same effect as though it were at the zero mark

and a weight of one, two, five or ten pounds, as the case may be, were placed on the scale pan at R. Under these conditions, calling x the distance from the zero mark to the outer mark a, and m the distance from the fulcrum to the knife edge supporting the scale pan, the general statement of the conditions that must be met is that the distance x multiplied by the weight r must equal the distance m multiplied by the weight R. The algebraic proof of this is as follows:

Since, when r is at position a, the effect is to be the same as though r were at zero and the weight R were on the scale pan, the moment of r in the first position must be equal to its moment in the second position plus the moment of the weight R, the moments being taken about the fulcrum F.

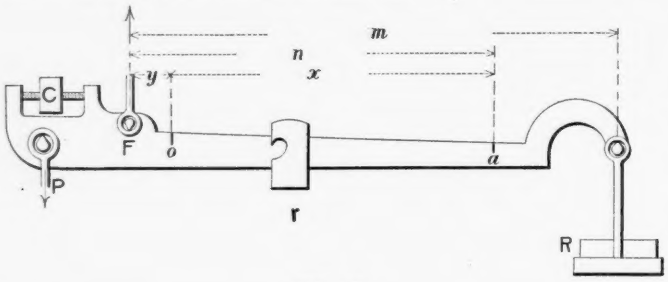


FIG. 13.

Hence, $rn = Rm + ry$ (Fig. 4)
Transposing, $rn - ry = Rm$
Factoring, $r (n - y) = Rm$.
But $n - y = x$
Hence. $rx = Rm$....................................(1)

In graduating a scale beam, therefore, we have four quantities to consider—namely, the distance x (Fig. 13), the distance m, the weight r and the weight R. Three of these quantities must be known or assumed, from which the fourth can be found.

To take an actual example, suppose $m = 30$ inches, $x = 22$ inches, $R = 2$ pounds, with r to be found. Substituting in equation (1).

$22r = 2 \times 30$.
$r = 60\text{-}22 = 2.73$ pounds.

Having determined these four quantities, the zero point of the graduations must be so located that the beam will balance with weight r at this point. F.

* * *

MILLING TO ANGLES.

Editor MACHINERY:

A few days ago I had occasion to do a small job of milling, which will, perhaps, be of interest to others, especially to those who have not had much experience at machine work.

The piece to be milled was a cylinder $5\frac{1}{2}$ inches long by 1 1-16 inches in diameter, and it was to have two surfaces milled longitudinally for a distance of $3\frac{1}{2}$ inches, such that the angle formed by these surfaces should be 100 degrees.

Fig. 1 shows a top and end view of the piece after having been milled.

As the index table with the Brown & Sharp milling machine told only how many turns of the index to make in order to cut a given number of teeth, I was at a loss to find how many turns to make in order to have the surfaces make the desired angle

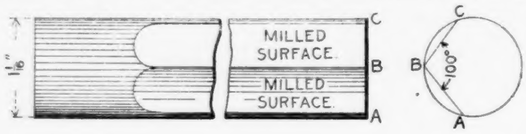


FIG. 1.

with each other. The foreman's instructions were to lay off the angle on the end of the piece by means of a protractor, and work to the lines. This seemed to me to be a clumsy and inaccurate way, so I decided to think a little about it before going to work, and by the following simple problem in elementary geometry, which I am sure will be understood by all, I was enabled to calculate the proper index movement with ease.

It is a well-known fact that if a line be drawn so that it just touches a circle, or, in other words, tangent to the circle, as A B, Fig. 2, and another line A O be drawn perpendicular to it (A B) at the point where it touches the circle, then the line A O will pass through the center of the circle. Likewise O C is perpendicular to B C, and also passes through the center. Since A O is perpendicular to A B the angle O A B equals 90 degrees; also angle O C B equals 90 degrees.

Now, if a line O B be drawn from O to the point B, where the tangent lines A B and B C meet, it will bisect the angles A O C and A B C, so that angle A O B equals angle B O C, and angle A B O equals C B O. Also, the sum of all the interior angles of any triangle is equal to 180 degrees. Hence in the triangle A O B the angle O A B plus angle A B O angle B O A equals 180 degrees. Therefore the sum of all the interior angles of the two triangles equals 360 degrees. But the angle B A O plus the angle B C O equals 180 degrees $= (90 + 90)$. Hence angle A B C plus angle A O C $= 360 - 180 = 180$ degrees, and angle A O C $= 180 -$ A B C.

Let us suppose the angle A B C to be 100 degrees, in order to conform to the problem which prompted this article. Then angle A O C equals $180 - 100 = 80$ degrees, which is the angle through which the cylinder must be turned in order to have the milled faces make the required angle with each other; for E D and D F (Fig. 3) are parallel to A B and B C, respectively.

Since there are 360 degrees in a complete circle, we will divide 360 degrees by 80 degrees ($360 \div 80 = 4\frac{1}{2} = 9/2$) to find what part of a complete circle 80 degrees is. This gives $4\frac{1}{2}$— i. e., there are $4\frac{1}{2}$ times 80 degrees in a complete circle.

With the machine used in this instance, it required 40 turns of the index to turn the work completely around once; so we divide 40 by $4\frac{1}{2}$, ($40 \div 4\frac{1}{2} = 40 \times 2\text{-}9 = 80\text{-}9 = 8\ 8\text{-}9 = 8\ 16\text{-}18$), which gives 8 16-18, the number of turns of the index required to turn the work through 80 degrees. Using the index circle marked 18, we have to make eight complete revolutions of the index, plus 16 of the divisions of the circle.

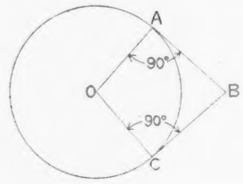


FIG. 2.

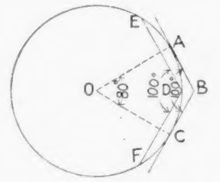


FIG. 3.

The above may be put into a rule as follows: First subtract the given angle from 180 degrees, which will give the number of degrees through which the piece of work will have to be turned. Second, divide 360 degrees by the number of degrees in this remaining angle. Third, divide the total number of revolutions of the index required to make one complete revolution of the work by the quotient last obtained. The result will be the required number of turns of the index.

All the figuring required for the problem is as follows:

$$\begin{array}{r} 180 \\ 100 \\ \hline 80)360 \\ \hline 4\frac{1}{2} = \frac{9}{2} \end{array}$$

$$40 \times \frac{2}{9} = \frac{80}{9} = 8\frac{8}{9} = 8\frac{16}{18}$$

The above rule will hold true for all angles less than 180 degrees, and for angles greater than 180 degrees, one should work from the other side of the circle. W.

* * *

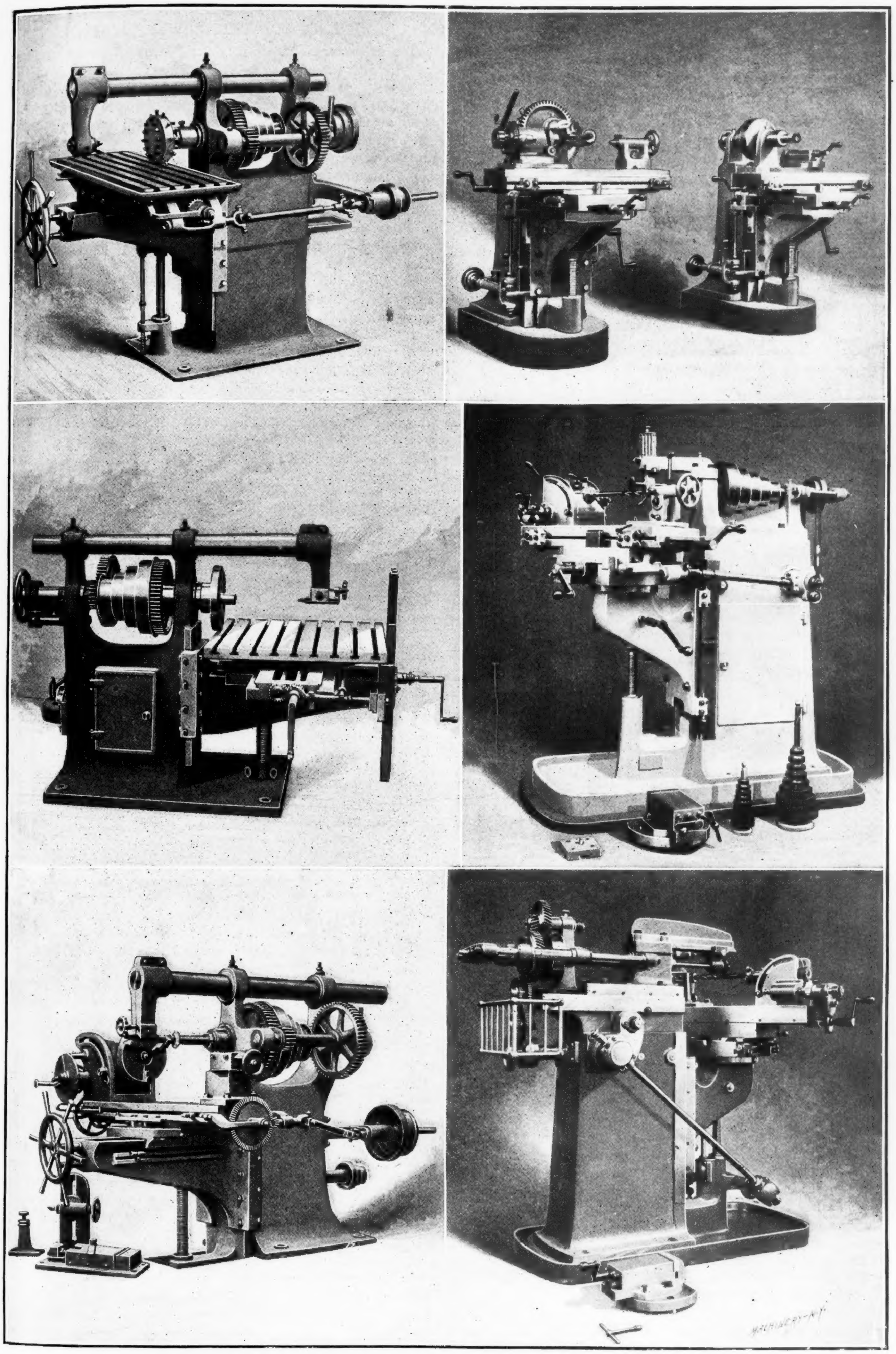
TYPICAL EUROPEAN MACHINE TOOLS.—1.

HORIZONTAL MILLING MACHINES.

On a full-page illustration are presented some cuts of milling machines designed and built in Europe, which may be of interest to the readers of MACHINERY. Excluded were designs which are built and labeled by our friends across the water as being "according to the American system." These latter often resemble our well-known types to a degree which robs them of all interest for us as far as construction or design is concerned. With us, it may be broadly stated, the machine with horizontal spindle occupies the prominent place, while the machine with vertical spindle is of a later birth and with preference used for special work. Not so abroad, where the vertical spindle machine is doing a large share of the regular work.

It is not the intention on the hand of the illustrations presented to discuss the merits and shortcomings of these machines, or to start or to invite such a discussion. These machines are brought before the reader, believing them to be of interest to those who are chiefly familiar with our American types. In the next issue some vertical milling machines will be presented.

C. C. S.



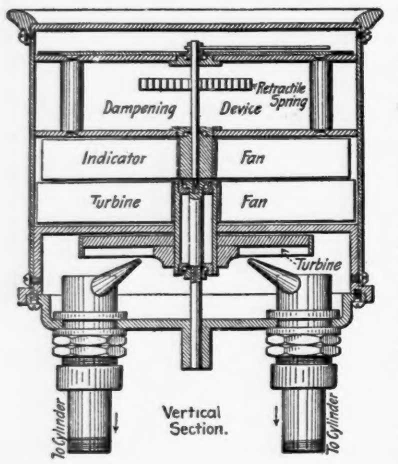
TYPICAL EUROPEAN MACHINE TOOLS—HORIZONTAL MILLING MACHINES.

[First of a Series of Illustrations showing the various Types of Machine Tools as they are now made in Europe.]

A NEW POWER GAUGE.

There have been many attempts to produce a continuous recording steam engine indicator, and one of the most promising has been put on the market by the Atwood Power & Speed Gauge Co., 95 Liberty street, New York. In the common understanding of the term it is not an indicator, but is more like a steam gauge, from the fact that the power developed at any instant is indicated by a pointer that moves over a dial, similar to the hand of a steam gauge. In fact, in outward appearance the instrument quite resembes a steam gauge.

Inside the casing of the instrument are three compartments, as shown in the accompanying sectional view reproduced from a recent issue of the "Engineering News," which contained a description of the gauge. In the rear compartment is a small turbine or fan wheel that revolves continuously in one direction under the impulse of steam jets coming alternately from each end of the steam engine cylinder from which the instrument is piped.



There are two nozzles connected with each pipe, or four nozzles in all, from which steam impinges against the turbine blades. Only two nozzles are in operation at the same time, however, one from each end of the cylinder, the others being cut off by valves operated by an indicator reducing motion, and the nozzles point in such a direction that the one connected with the steam end of the cylinder will tend to urge the wheel in the direction in which it is turning, while the other, which is connected with the exhaust side, will always tend to oppose the motion of the wheel. The wheel is light, responds quickly to a change of pressures, and its speed therefore is exactly, or at least very nearly, proportional to the difference between the velocities of the steam emerging from the two nozzles, and hence proportional to the mean effective pressure of the steam in the engine cylinder. Many experiments have been made with the instrument and the action of the turbine has been found to be as calculated within all practical limits.

In the second compartment are two fans whose axes are in line with each other, but which are in no way connected. The first fan is fastened to the turbine shaft, which extends through to the second compartment, and has the same velocity as the turbine. The second fan is upon a shaft that extends through the third compartment of the instrument to its face, where the pointer is fastened to the other end of the shaft.

This fan, being closely confined in the same compartment with the first one, tends to turn with it through the effect of the air currents set up by the motion of the latter. If there were no resistance to the motion of the second fan, it would manifestly revolve with the first one and at about the same speed, carrying the pointer along with it. In the third chamber, however, are a spiral retractile spring and a dampening device that act to oppose any motion of the second fan, so that, instead of revolving with the first fan, it simply deflects or turns a short distance in the direction in which the first fan is moving, and if the velocity of the first fan is constant, it is clear that the second fan and the pointer will remain deflected at a certain point; but where the speed of the first fan varies, as it does in actual operation, the pointer will move back and forth, indicating the amount of variation.

To enable the instrument to take account of the vacuum if a condenser is used, the turbine chamber is piped to the exhaust pipe of the engine. The pressure in the chamber will therefore correspond to the pressure in the exhaust pipe, and will correspondingly affect the velocity of the steam jets.

This power gauge can be attached permanently to an engine cylinder so that the power used at any time can be read at a glance. It is stated by Mr. Atwood that repeated experiments show that it will record within 1 per cent. of the results given by an indicator.

THE NEW BATTLESHIP "MAINE."

The sixth annual meeting of the Society of Naval Architects and Marine Engineers was held at the rooms of the American Society of Mechanical Engineers, New York, on Nov. 10 an 11. This society includes in its membership the leading shipbuilders and naval constructors of this country, and the papers presented at this session were of unusual interest, owing to their bearing on the action of the naval vessels in the late war, and called out a large attendance of members.

To the non-technical reader, and perhaps to the technical reader, as well, the most interesting paper was the one by Chief Constructor Philip Hichborn, U.S.N., upon the "Designs for the New Vessels for the U. S. Navy." The text of the paper was short, but it was accompanied by a large number of drawings of the latest designs for the navy that are of exceptional interest and value. Of these we reproduce two views on the opposite page of the new battleship "Maine," which is one of the three battleships recently authorized by Congress. Concerning the views submitted, Mr. Hichborn states that the general plans of the "Maine" may be varied somewhat in the other vessels as regards the engines and boilers, but that they may be considered as fairly representing the class. The following are some of the more interesting dimensions and particulars:

Hull.

Length over all	393 ft. 9 ins.
Extreme breadth	72 ft. 2½ ins.
Speed per hour in knots	18
I. HP. with assisted draught	1,600
Mean draught, with all provisions, stores, ammunition and 2,000 tons of coal on board	25 ft. 6 ins.
Corresponding displacement	13,500 tons

Armament.

Main battery	4 13" B. L. R. 14 6" R. F.
Secondary battery	20 6-pdr. R. F. 6 1-pdr. R. F. 4 Gatlings. 1 field gun.

Machinery.

Vertical, inverted cylinder, direct-acting, triple expansion engines, in two water-tight compartments.

Collective I. HP. of propelling, air-pump and circulating pumping engines	16,000
No. of revolutions at this power	126
Diameter of high-pressure cylinder	38½ ins.
Diameter of intermediate cylinder	59 ins.
Diameter of low-pressure cylinder	92 ins.
Length of stroke	42 ins.
Cooling surface, main condenser	9,600 sq. ft.
Cooling surface, auxiliary condenser	800 sq. ft.

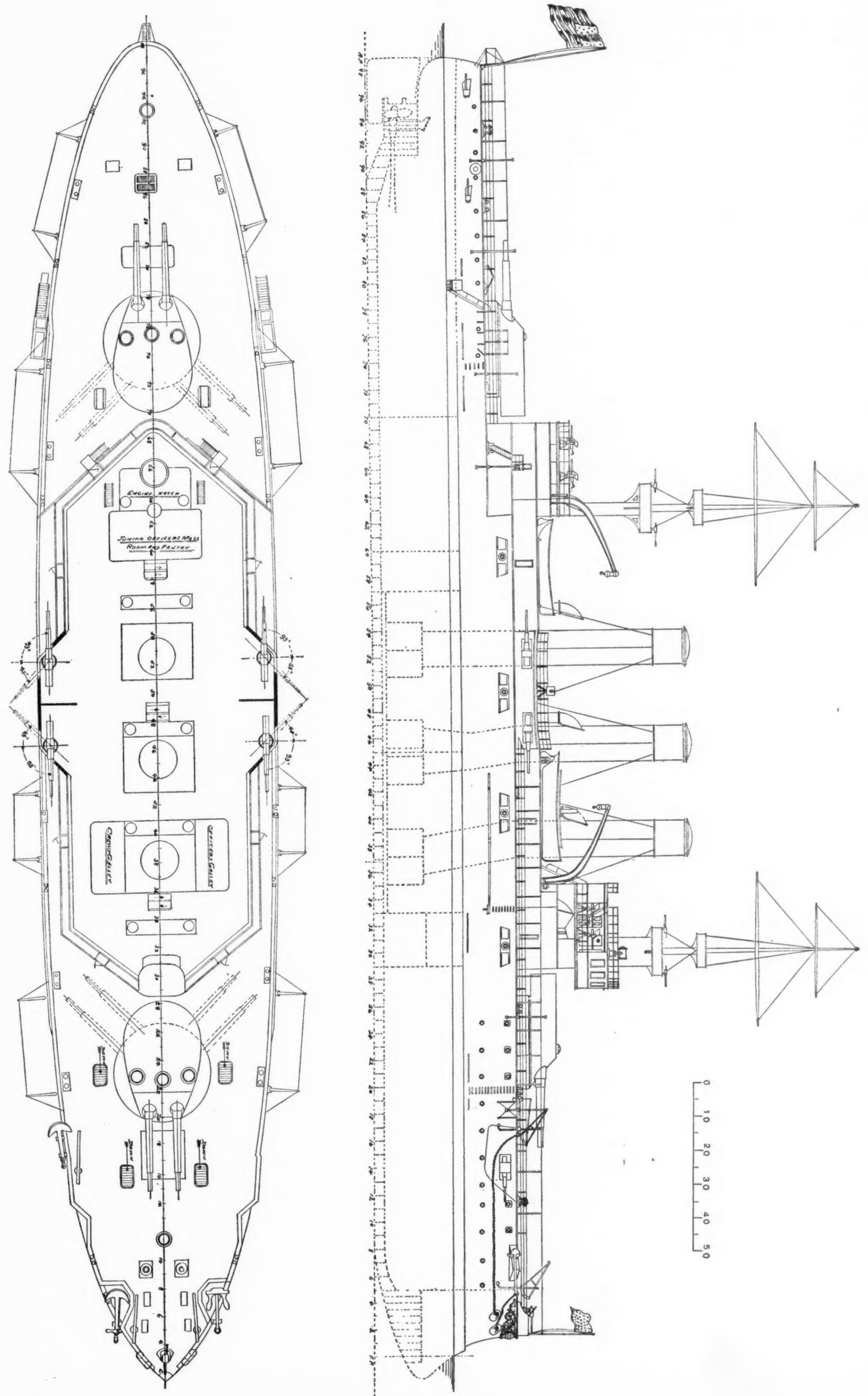
The boilers are of the water tube type arranged in three groups of eight boilers each. The total heating surface will be 58,104 square feet, and the grate area 1,353 square feet. Working pressure 250 pounds per square inch.

The heaviest armor will be on the forward turret and will be 17 inches thick. The main belt is to be 12 inches thick and the side armor above the main belt and the superstructure armor 5½ and 6 inches thick respectively. The protective deck will be 2¼ to 4 inches thick.

Regarding these particulars Mr. Hichborn says that there will probably be a reduction in the thickness of the heavy armor of at least 25 per cent., owing to the introduction of the Krupp process into its manufacture, and that the latest type of 12-inch gun will probably be substituted for the four 13-inch guns, the change allowing an increase in the number of 6-inch guns to sixteen. The new 12-inch guns will be fully as effective as the old 13-inch, and we all trust and believe that the new "Maine" will bear her colors gloriously and be a worthy namesake of the smaller but far-famed vessel of our navy.

* * *

In the current issue of "Cassiers" Chas. H. Haswell gives an account of early marine engineering in the United States. He states that up to 1836 the only fuel used was pine wood, and that a vessel bound for a voyage of six hours or more was obliged to go out with wood piled on the side houses and upper deck, giving it the appearance of a woodyard more than anything else.



SIDE ELEVATION AND UPPER DECK PLAN OF THE NEW BATTLESHIP "MAINE." FROM DRAWINGS PRESENTED BY CHIEF CONSTRUCTOR HICHBORN, U. S. N., AT THE RECENT MEETING OF THE SOCIETY OF MARINE ENGINEERS AND NAVAL ARCHITECTS, HELD IN THIS CITY.

NOTES FROM A ROVING CONTRIBUTOR—9.

STRANDED ON A FOREIGN SHORE—WHERE THE WEATHER COMES FROM—WATER ON THE PACIFIC COAST—A QUOTATION ON HIGH PRESSURE—A SAWDUST FACTORY—SEWARD'S PROPHECY.

Thirty months ago the "contributor," after wandering off to this western verge of the Continent in search of notes, subsided, as the readers of MACHINERY may remember. Being at home in all places, he went into retirement over the draughting board and let the machine shops and the rest of the world wag on without his aid for thirty months—a whole age at this day. This interregnum, as the historians say, came to an end recently by reason of a letter from the Editor saying: "Look about and send in something." This I am glad to do. There is plenty of material; not frontier yarns, because this district is in the interior now since our domain reaches over the Aleutian Islands and the Malay Archipelago. There is a world of new things that will work up into notes, especially as I can trench upon pure science, now that the Professor is out of the way. He has been promoted—has had three or four more letters added to his title—and is not bothered any more with useful problems. The people who live in that portion of the empire called the Eastern States do not, one in a thousand, know that the weather they experience is mainly manufactured up here about Puget Sound, or north of the Straits of San Juan de la Fuca, which translated means, the south and main entrance to these inland seas called the "Sound." The Japan current comes racing across the Pacific Ocean as the Gulf Stream does across the Atlantic, impinging normal to the coast line up about Queen Charlotte Island, distributing its aerial waves of moisture and temperature nor'east, east, and southeast, keeping the weather bureau men in a perpetual stew, so to speak. It is easy enough in the Mississippi Valley and still easier east of there, to make up a weather chart, but what is the bureau to do with 3,000 miles of clear water to weatherward and no stations between here and the Asiatic coast.

Then, again, the pranks played by these weather currents on this coast! By the time the meteorological waves get over the Rocky Mountains they are broken up—blended, so they call it—gather intensity in the wind currents, but the "precipitation," as the professor calls it, is normal. In its hurry to get inland or by some kind of grand aerial eddy, this moisture misses a great notch in the Continent, a thousand miles long and three to six hundred miles deep, where no rain falls for half the year, and for the whole year in some places amounts to only 3 or 4 inches. In this district, which includes most of California, water is to the people what the sun and its heat was to the ancient Persians—the life-giving principle that lies at the bottom of all human interests.

I have come this long way around as an introduction to "water." This fluid will have much to do with these notes, directly or indirectly, and first I must explain that the run-off water does not, as east of the mountain ranges, go meandering through hundreds of miles of fluvial plains. The mountains are shoved out near the edge of the continent with only a narrow strip between them and the sea, and send down their water in torrential streams, mostly small in volume but many in number and most of them wrong-end foremost—that is, more water at the head than at the foot—the smaller ones with no water at all at their mouths in summer. This abrupt slope to the Pacific shore and utilization of the water-shed brings us to machinery.

In the Eastern States forty-nine water wheels out of fifty are of the pressure turbine type, and on the California coast forty-nine are impulse wheels and one is a pressure turbine. The latter is a creation of mathematics, except the inward discharge, or centripetal type, which has been whittled out by American makers in controversion of old formulae, but is one of the best of all. I call them pressure wheels because they are filled, and the principal of their action is that of "obstructed flow." Impulse wheels are open, not filled, and act by the impingement of spouting water. A common head for Eastern wheels is 10 to 30 feet; for the impulse wheels is from 200 to 1,000 feet, and as much more as can be got. Sometimes 2,000 feet, as at Virginia City in Nevada. Some have been sent out to London to operate under a pressure of 700 pounds to an inch, equal to a head of 1,600 feet.

The floats, vanes, or buckets on these wheels form a theme for endless discussions, experiments and patents, owing to a perverse habit of the water, which, after impingment in the buckets, refuses to follow the resultant angle prepared for it; also ignores other ingenious computed results. Just at the time of writing this I happened to meet an old student friend of mine who had been fooling around a hydraulic plant with a head of 1,400 feet to deal with. This means a pressure of 600 pounds per inch, a velocity of 300 feet per second, and other things in proportion, including the jet boring of a hole through a steel plate ⅜ inch thick in one night.

My friend, while he had forgotten some grammar, had balanced up the loss with his experience in hydraulics. His remarks were about as follows:

"Napoleon conquered most of Europe, and this was quite a job, but a greater thing he done was to set a lot of learned Frenchmen at work to study out the action of fluids. They got on well, so well indeed, that there has not been much done in that line since, but, let me tell you, those fellows were only at the threshold, so to speak. What does all their computing amount to, or their work either, for that matter, when you come to deal with water under a head of 1,400 feet. Napoleon should have set his artillery officers at the work. They would have known more about pressures, at least; but static pressure is not the point, at least not the main point. Suppose you had a pipe a mile long with 250 tons of water in it, or, what is the same thing, an iron shaft, 6 inches in diameter and a mile long, to deal with—that is, to start and stop it endwise. Suppose further that this bar of iron is leaned up against a mountain at an angle of 1 foot in 4, frictionless, and pulling downward with a force of 60 tons, or 600 pounds per inch. When this water is turned loose it starts off at a rate of 300 feet per second—18,000 feet, or about 3.4 miles a minute—and to check its flow in the pipe means destruction. A water wheel 4 feet in diameter driven by the water would run at 1,500 revolutions per minute, the rim moving 150 feet per second, which nothing but the strongest steel or bronze will stand. Take my advice and don't fool around mountain water wheels out here."

These remarks excited my curiosity, and certainly water at such a pressure must develop some material for notes when I get to the place.

Just now I am puzzled over a branch of industry extensively carried on out here—the manufacture of sawdust. It is produced by means of circular saws, that convert about a third of the cubic contents of the logs into good, marketable sawdust. The balance is saved and sold as "lumber," which properly means waste material. Out of a log 20 feet long that will square 18 inches or 45 cubic feet, these people get 360 feet of 1-inch boards and about 150 feet, board measure, of sawdust. I have seen sawing done in many parts of the world, but nothing to equal this. Band saws are coming in and the "lumber" product in proportion to sawdust is increasing. One man informs me that "nothing was wasted, because the sawdust made fuel, and that a thick saw took no more power than a thin one."

Such timber as grows here! The cedars of Lebanon are as poles in comparison, and the great slide at Alphach never knew such trunks as grow in Oregon and Washington; also, no doubt, in that vast country, almost unexplored, that lies about Olympian Mountains, north of here. Nature's bounties in all that should render life a pleasure lie about here in profusion—wood, water, coal, iron, fertile land, a congenial climate, natural harbors, water power and the rest. No wonder William H. Seward in his tour around here about thirty years ago predicted that in the future this country would teem with a population outreaching the Atlantic seaboard. Prophesy is easy and tolerably sure in a case like this, except as to the element of time. William was no doubt right. He generally was right in his conclusions. I could improve on him but would lose my copy. The Editor cuts out the prophesy.

* * *

Captain Sigsbee spoils a good story, but replaces it with another equally good, in denying, as he will in the December "Century," that his orderly entered the cabin of the "Maine" immediately after the explosion, made a formal salute, and reported the destruction of the ship. As a matter of fact, the orderly ran into his commanding officer in a dark passage leading forward through the superstructure, and reported that the ship had been blown up and was sinking.

MARINE ENGINE DESIGN.—7.

THRUST BEARINGS.

WILLIAM BURLINGHAM.

A thrust block or bearing is one of the most important parts of a marine engine, and on its good behavior often depends the successful working of the same.

It should run day and night with practically no attention; it should be able to stand the racing of the engine in a heavy sea and its maximum pressure when bucking against a head wind and tide.

Experience has taught us the maximum pressure per square inch that can be allowed for the successful working of this bearing under all conditions, and we must not depart from those premises.

The first essential in designing a new thrust block is to find the total indicated thrust for one engine. From that is deduced the number of square inches of surface that is required.

The following formulae, A and B, are the two generally used for this purpose. The "A" formula gives the mean normal thrust, used mostly in English practice, and "B" the total indicated thrust used by our own designers. In this article I have used formula "B" exclusively.

Formula "A":

Let S = speed of ship in feet per minute.

Let K = speed of ship in knots per hour.

Let N. P. = mean normal thrust pressure against the collars.

For all practical purposes the effective indicated horse-power—that is, the power actually employed in propelling the ship—may be considered as equal to two-thirds of the indicated horse-power.

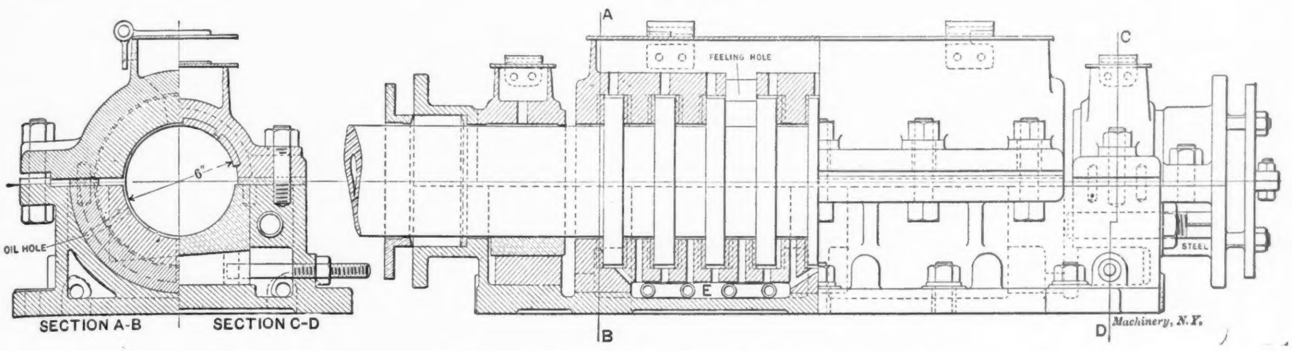


FIG. A. RING TYPE OF THRUST BEARING.

There are two principal types of thrust blocks—the ring, or collar bearing, and the horse shoe. The former is used mainly in naval work, and the latter, until lately, almost exclusively in the merchant service. For the past three or four years, however, the naval engineers have approved the use of the horse shoe type of thrust in their vessels.

The reason that the ring type has been used so much in navy work is that it has a larger area of bearing surface per pound weight of thrust bearing—a weighty consideration in marine work—and also that it is considerably shorter than the other type for the same surface. As long as no heating takes place, the ring thrust does very well, but once it gets out of order it is difficult to deal with, and impossible to adjust at sea. In addition it is more apt to heat, because the rings are entirely enclosed and the bearings lack means of individual adjustment.

The horse shoe type, although longer and heavier, is more accessible and easier to handle. It is capable of adjustment, each horse shoe singly or all together. The open space between the horse shoes allows of easy examination of each collar and permits the air to exercise a much needed cooling effect on the same.

Then
$$\text{N. P.} = \frac{\text{I. HP.} \times 33\,000}{S} \times \frac{2}{3}$$

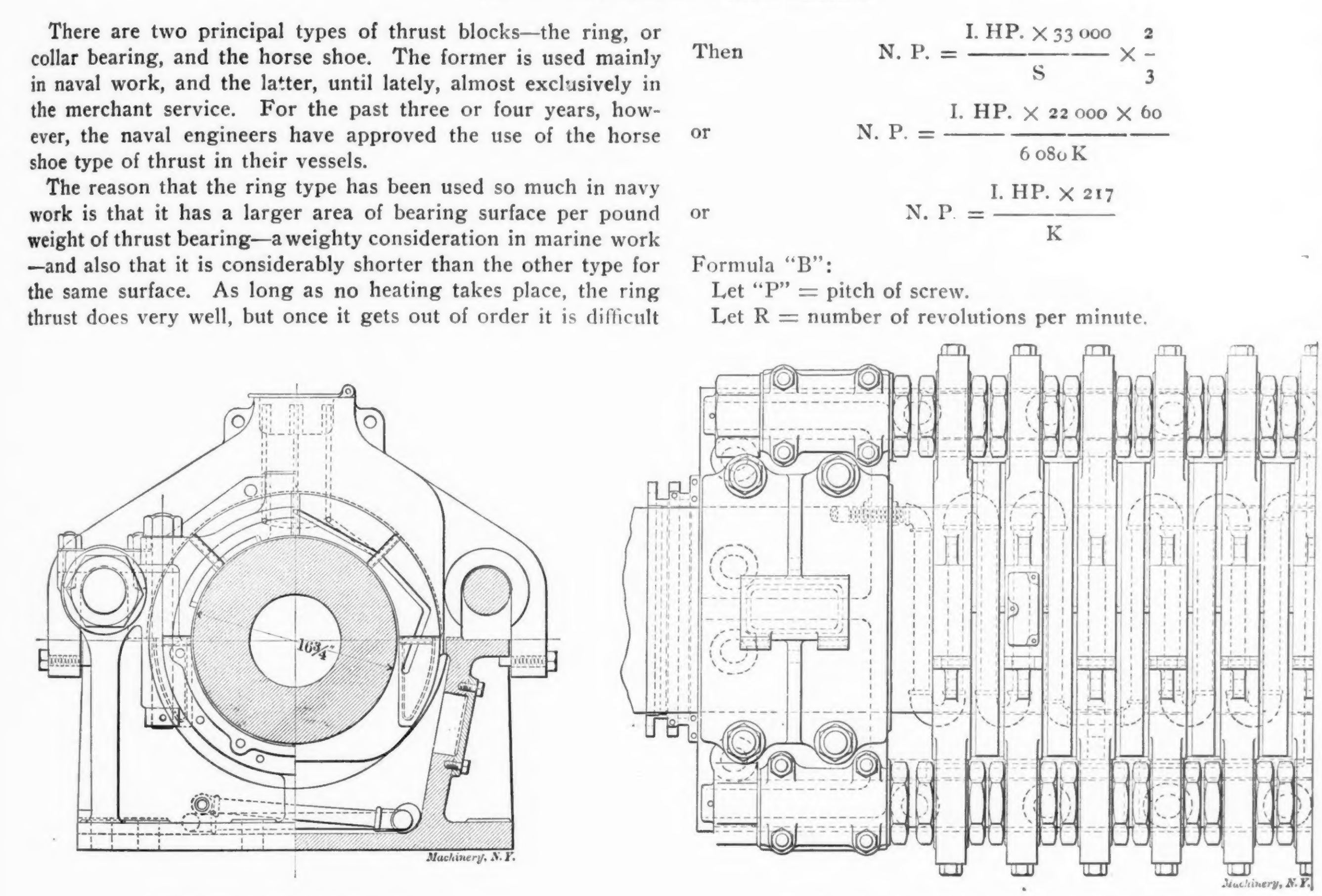
or
$$\text{N. P.} = \frac{\text{I. HP.} \times 22\,000 \times 60}{6\,080\,K}$$

or
$$\text{N. P.} = \frac{\text{I. HP.} \times 217}{K}$$

Formula "B":

Let "P" = pitch of screw.

Let R = number of revolutions per minute.



END VIEW AND HALF SECTION. PLAN VIEW OF FORWARD HALF OF BEARING.

FIG. B. ADJUSTABLE HORSE SHOE TYPE.

Then total indicated thrust $= \dfrac{\text{HP.} \times 33\,000}{\text{P.} \times \text{R.}}$.

As the thrust pressure per square inch is constantly varying, it must be made such that the bearing will work well under any condition.

The kind of service and the water in which the ship is to steam are factors governing the pressure per square inch. In still river and lake waters a much lighter thrust pressure can be allowed than possible under rough sea-going conditions.

Having found our total thrust, it is divided by the desired pressure per square inch to obtain the total required area of bearing surface. The U. S. S. "New York's" thrust figured by formula "B" is thus:

It is of the horse shoe type.

I. HP. = 16,947 for four engines; two engines are coupled to one shaft.

Revolutions per minute, 134.8.

Bearing surface of collars, 1,390 square inches.

Pitch of propellers, 21 feet 0 inches.

$$\text{Total indicated thrust, } \frac{8473.5 \times 33\,000}{21 \times 134.8} = 98{,}775 \text{ pounds.}$$

gether, an allowance must be made in case one or two collars have to do the entire work. The larger the collar the better able is it to do this work, but if we make them too large the speed of the rubbing surfaces becomes too great and the cost of forging is considerably increased.

We must strike a golden mean for these diameters; one that practice proves correct. That is, make them from 1.33 to 1.53 times the diameter of the shaft, the prevailing practice at present being to make them about 1.39 times the shaft diameter. It follows that the numbers of collars is found by dividing the total indicated thrust by the net available area per collar. The thickness of collars of the ring type, with bearing all around is found

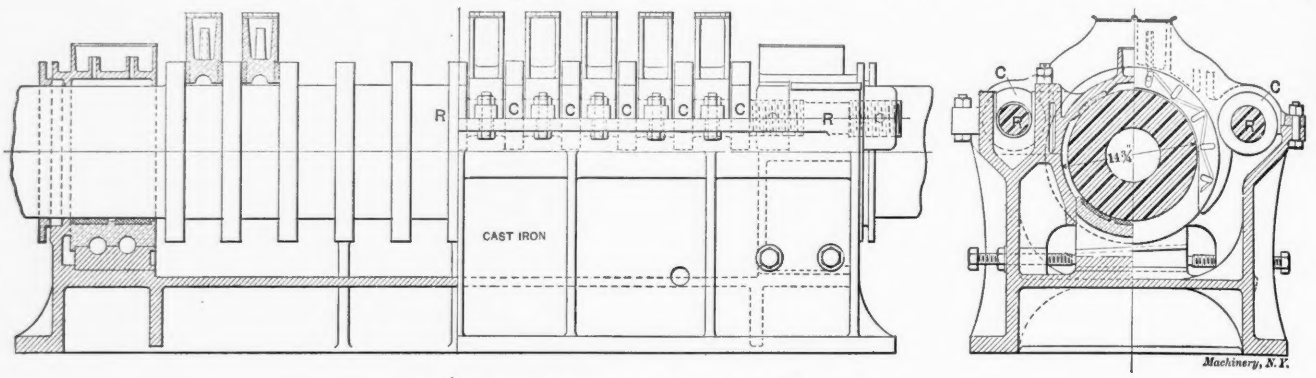


FIG. C. HORSE SHOE TYPE USED ON THE OREGON.

$$\text{Thrust per square inch } \frac{98\,775}{1390} = 71 \text{ pounds.}$$ There are twelve collars, with a collar bearing surface of 2,784 square inches and a designed thrust per square inch of shaft collars of 35 pounds, but as the ratio of the actual thrust surface to the surface of the shaft collars is about 50 per cent., the actual bearing surface becomes 1,390 square inches and the pressure 71 pounds. One must be careful not to take the area of the shaft collars as total bearing surface, or trouble will surely arise.

The thrust pressures per square inch of some United States naval ships are as follows:

	C. Surface of Thrust Shoes. Sq. inches.	D. Surface of Shaft Collars Sq. inches.	Ratio, C to D.	Ind. Thrust per sq. inch. Lbs.	Type of Thrust.
New York..........	1 390	2 784	.50	71	Horse shoe.
Monterey..........	704	725	.97	62	Ring.
Brooklyn..........	1 390	2 784	.49	79	Horse shoe.
Ind ana............	1 452	2 176	.66	51	" "
Iowa...............	1 650	2 527	.65	55	" "
Massachusetts.....	1 452	2 176	.66	54	" "
Columbia..........	1 650	2 527	.65	42	" "
Minneapolis.......	1 650	2 527	.65	46	" "
Wilmington........	268	312	.85	58	Ring.

The pressure from 50 to 60 pounds in the better practice. The higher pressures of the "New York" and "Brooklyn" are due to the fact that they seldom run at their maximum power, and consequently the high thrust pressure is not often reached.

Torpedo boats average about this same pressure. For instance:

Name of boat.	Thrust press. per sq. in. of surface.
Foote	55
Porter	62
Rowan	58
Davis	50
Mackenzie	45

The merchant service pressures are considerably lower, because the engines are running almost constantly at their maximum power. They have but little time for overhauling, and the construction of the ship is usually lighter than a naval boat and more liable to spring the shafting out of line.

The indicated thrust per square inch, then, for the merchant marine may vary from 28 to 40 pounds, the pressure mostly used being 32 pounds. The area taken up by the oil holes and grooves must be subtracted from the total area of shoes or rings. The ratio of the actual thrust surface to the area of the shaft collars for the horse shoe type is about 66 per cent. For the ring type it varies from 85 to 95 per cent.

The number of collars depends in a measure upon the size of the engine and the opinion of the designers. If there are many collars, they must of necessity be somewhat small, and although we can safely assume that a majority of them are bearing to-

from the following formula, empirical but accurate enough for all practical purposes:

$$\text{Thickness} = .2\,(D - d) + .4 \text{ inch for ring type,}$$
$$\text{Thickness} = .23\,(D - d) + .4 \text{ inch for horse shoe type.}$$

The space between the collars for the ring type of bearing, when the go-ahead and go-astern surfaces are entirely covered with white metal is equal to

$$\text{Space} = .4\,(D - d) + .6 \text{ inch.}$$

For the horse shoe type faced as before on both sides, if of cast steel, the

$$\text{space} = 1.62\sqrt{(D - d) - 1.5}$$

If of cast iron the space is about 15 per cent. wider.

The prevailing practice in this country, where mild steel shafts are almost entirely used, is to face the bearing surfaces with white

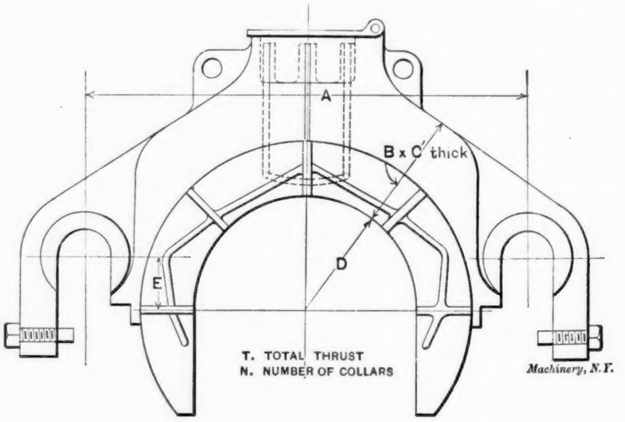


FIG. D. DETAIL OF HORSE SHOE

metal, and the necessity of a superior quality of this metal cannot be too strongly emphasized.

In England, with wrought iron shafting, composition or brass shoes and bearing surfaces are used, especially on old tramp steamers, such as the British ship owner delights to scatter over the globe.

If ring bearings are used, it is necessary to provide a cast mandrel for relining the bearings. In finishing this mandrel allowance must be made for the contraction of the white metal in cooling. Before the bearings leave the machine shop they should be carefully scraped and bedded to the shaft.

The bodies of all types of thrust bearings should be cast hollow for a continuous circulation of water, and the oil in the bottom is rendered much more effective by running a small copper water pipe through it for cooling purposes.

The packing under the sole plate of the thrust block is best if made of metal wedges and the foundation should be strongly

built in the ship, the floors or frames forward and aft and under the sole plate being strongly bracketed or tied together, as the total thrust of the engine is localized at this point, and unless the thrust is well secured there will be trouble for the engineers.

Fig. A is a design of the ring type for naval ships, and is in actual service and doing well. The base casting is bored out to contain the lower half of the ring bearing; the upper half is bolted to the base, and at either end is a bearing to take the weight of the shaft. This is a feature common to all thrusts, and is an absolute necessity. These bearings are adjustable by means of wedges. Outside of the bearings are stuffing boxes, making the base casting oil-tight.

The upper half of the ring bearing is cut away in two places for feeling the shafts, and generous oil holes lead from the oil boxes on top to all the bearing surfaces. The tube, shown in the lower space at E, is connected with the water service and cools the oil.

The block rests upon a sole plate, and is adjustable thereon, either fore and aft or athwartship by means of metal wedges or keys. Those relieve the base bolts of the shearing strain, due to the thrust of the engine.

Fig. B shows the horse shoe type. The horse shoes are adjustable, individually by means of the thin nuts each side of the shoe, or collectively by the nuts at either end of the side rods.

This is the best type of bearing, and is almost universally used, subject to minor changes in the details, depending upon the individual taste of the designer. It has the same oil well and cooling pipe as the other, and with the exception of the horse shoes is very similar to the ring type.

In this type the entire thrust is taken by the two side rods, and the working load per square inch of metal for steel of 65,000 pounds should not be more than 5,000 pounds. The thin nuts are made of brass or composition, so that they will not rust upon the rod.

The thickness of white metal on the bearing surfaces varies from 3-16 inch for a 6-inch diameter shaft to 3/8 inch for a 14-inch shaft, exclusive of the dovetail recess.

The base castings of the larger bearings have hand holes for cleaning purposes.

Fig. C shows a type of the horse shoe bearing that has no individual adjustment of the shoes. This is the type that is installed in our now famous battleship "Oregon." The side rods are shown at R, R, and metal separating collars solid to the rods appear at C, C, C.

Fig. D shows a horse shoe with dimensions from various ships.

	T.	N.	A.	B.	C.	D.	E.
Kearsarge.........	80 878	11	29	6 3/8	2 1/2	7 1/8	3
Oregon	72 518	11	25 1/4	6	3 3/4	7 1/8	3 5/8
New York.........	97 452	12	31 1/2	8 1/4	3 1/2	8 5/8	4
Iowa,.............	82 735	11	30 1/2	8 1/2	3	8	3 1/2
Annapo is.....	15 000	6	18	5	2 3/4	3 5/8	1 1/8
Indiana	72 578	11	27 3/4	7 1/2	3 1/4	7	3 1/4

Torpedo boat thrusts follow the general design of the ring type, and are made as light as is consistent with strength, and every ounce of metal that is not actually needed must be omitted.

In some cases the thrusts are bolted directly to the engine bed plate. Another method, used by a famous French torpedo boat builder, is to support the entire block on trunions with a slight play endways, taken up by circular flat plate springs. This is supposed to yield to the spring of the shaft, and keeps the surfaces in true bearing.

When the horse shoe type is used in torpedo boat work, the side rods are often omitted and the shoes slid into grooves in the bedplate of the thrust. This allows no end adjustment except by moving the entire thrust, but as these boats are in service for short intervals of time only, this does not matter so much as in other classes of ships.

In closing, I would say, make your thrust pressures low, your oiling grooves large, your bolt stresses low and your bearing surfaces of the best white metal procurable in open market. Make provision for a water service. Tap for lifting bolts in every piece that has to be lifted, and use large starting screws wherever there are two surfaces bolted together.

Before leaving shore be certain that your mandrel is of the exact size for relining your bearing properly.

CAPACITY OF A STEEL CHIMNEY.

W. WALLACE CHRISTIE.

Some time ago, when looking over the results of boiler tests made by the writer, he came across two which were made with the same installation of two Manning vertical boilers connected close to one steel chimney; the results obtained have a noteworthy similarity as to equivalent evaporation per pound of combustible, and the amount of dry coal burned per hour, as can easily be seen by reference to the appended report of the tests.

Both of the tests were made by the same observers, and the alternative method, suggested by the American Society of Mechanical Engineers, and while the same equivalent evaporation per pound of combustible was obtained in both cases, it is interesting to note that in the bituminous coal test the force of the draft and temperature in the chimney just above the flue entrance were both higher than in the anthracite coal test.

The coal capacity of the chimney, according to the writer's "Chimney Formulae and Tables," is 1,638 pounds of coal burned per hour; 1,865 pounds and 1,902 pounds were actually burned per hour, and that, too, with natural draft.

Had the piping arrangements of the boiler room been arranged for it, the boilers could have made considerably more steam.

The mean draft observed was only a small amount less than the theoretical draft for the chimney temperature and outdoor temperature of the air, thus:

The 0.48 inch observed, should be 0.556 theoretically. The 0.55 inch observed, should be 0.624 inch theoretically.

Trowbridge gives the pounds of coal burned per hour per square foot of grate 19 pounds, for a chimney 100 feet high, with a ratio of chimney area to total grate area of 8 to 1, In this case the ratio is 8.3 to 1, and the rate of combustion 17.8 and 18.15 pounds; or considering Trowbridge's figure of 152 pounds of coal burned per hour per square foot of section of chimney flue we get 18.23 as the rate of combustion for this particular plant, where 17.8 and 18.15 have beeen observed.

TABLE SHOWING COMPARATIVE RESULTS OF ANTHRACITE AND BITUMINOUS COAL.

Duration of trial	9.75 hours	10 hours
Dimensions and proportions:		
Grate surface (8 ft. 2 ins. diam.) each, total..	104.76 sq. ft.	104.76 sq. ft.
Total heating surface	7,500 sq. ft.	7,500 sq. ft.
Ratio of heating surface to grate surface....	71.6 to 1	71.6 to 1
Chimney, steel, 4 ft. diam. by 100 ft. high.		
Average Pressures:		
Steam pressure in boilers by gauge.........	69.15 lbs.	70.59 lbs.
Atmospheric pressure, per barometer.........	30.35 in.	29.9 in.
Chimney draught in inches of water........	0.48	0.55
Average temperature:		
Of external air	45 deg. F.	42 deg. F.
Of escaping gases	372 deg. F.	427.16 deg. F.
Of feed water	164.72 deg. F.	171.31 deg. F.
Fuel:	Scranton buckwheat	Daghuscahonda bit. lump.
Total amount of wet coal consumed........	19,265 lbs.	19,343 lbs.
Moisture in coal	3.70 per cent.	3.57 per cent.
Total refuse, dry	3,727 lbs.	1,288 lbs.
Total combustible (dry coal, less refuse).....	14,826 lbs.	17,365 lbs.
Dry coal consumed per hour.................	1,902 lbs.	1,865.3 lbs.
Combustible consumed per hour	1,520 lbs.	1,736.5 lbs.
Results of Calorimetric Tests:		
Quality of steam, dry steam taken as 100....	99.41	100.98
Water:		
Total amount of water pumped in boiler and apparently evaporated	135,032 lbs.	156,709 lbs.
Water actually evaporated corrected for quality of steam	134,235 lbs.	158,245 lbs.
Equivalent water evaporated into dry steam from 212 deg. F............................	145,201 lbs.	170,392 lbs.
Equivalent water evaporated into dry steam from and at 212 deg. F. per hour..........	1,489 lbs.	1,703.9 lbs.
Economic Evaporation:		
Water actually evaporated per lb. of dry coal from actual pressure and temperature........	7.28 lbs.	8.40 lbs.
Equivalent water evaporated per lb. of dry coal from and at 212 deg. F................	7.82 lbs.	9.13 lbs.
Equivalent water evaporated per lb. of combustible from and at 212 deg. F...........	9.80 lbs.	9.81 lbs.
Rate of Combustion:		
Dry coal actually burned per sq. ft. of grate surface per hour	18.15 lbs.	17.80 lbs.
Rate of Evaporation:		
Water evaporated from and at 212 deg. per sq. ft. of heating surface per hour........	0.198 lbs.	0.227 lbs.
Commercial Horse-Power:		
On basis of 30 lbs. of water per hour evaporated from temperature at 100 deg. F. into steam of 70 lbs. gauge pressure, equals 34½ lbs. from and at 212 deg. F...........	431.65 HP.	493.86 HP.
Horse-power, builders' rating	500 HP.	500 HP.
Per cent. developed below rating............	13.67 per cent.	1.22 per cent.

* * *

A correspondent in England asks to have the subject of "Coned Bearings, Their Relative Advantages and Disadvantages," discussed in our columns. We shall be glad to present the experience of any of our readers regarding this form of bearing.

MORE "MUCKETS."

JOSEPH B. HALL

Round core boxes of any length, when made by hand are costly, and even when care is exercised by working to templet are apt to be untrue. I herewith submit a fixture for the ordinary lathe used by pattern-makers, which is a modification of machines built specially for the purpose. It can be cheaply made and will save considerable time over hand work, even

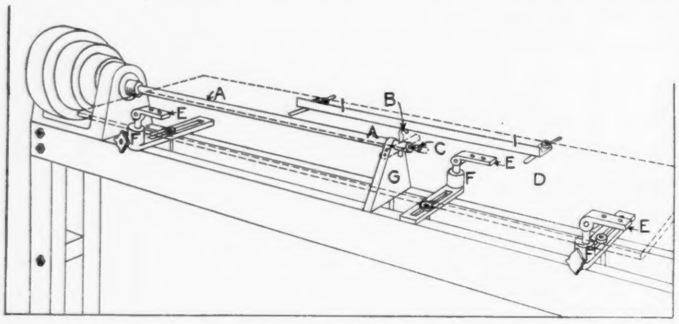


FIG. 1.

if it has to be adjusted for only one job. Figure 1 shows a perspective of it. A shaft A is fastened to the lathe spindle, and near the end of which is drilled a hole for the shank of tool B to fit in, which is held in place by a set screw C, in the end of shaft. The cutter B is shaped as shown in figure 2, of which several should be provided with different lengths of shank, as the various diameters are made by altering the distance of the cutting edge from shaft. The table D is shown in

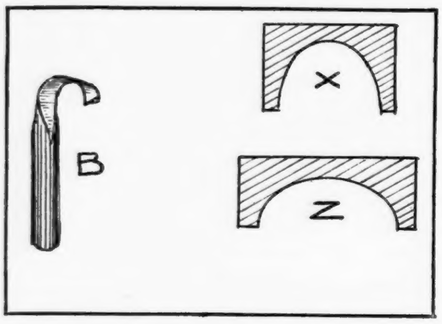


FIG. 2.

dotted lines, and has a slot in the head half to permit shaft A to enter. The top of table is on the axis of the shaft. The table is supported by three cast-iron hinged pieces E, which are fastened to the table and fit into hand rest sockets F. By this means they are adjustable as to height. Under the table, near the end of the shaft, is a half bearing G, into which shaft A is kept by a thin metal strap.

The guide I is ordinarily parallel to the shaft, when semi-circular grooves are cut, but when semi-elliptical grooves are cut

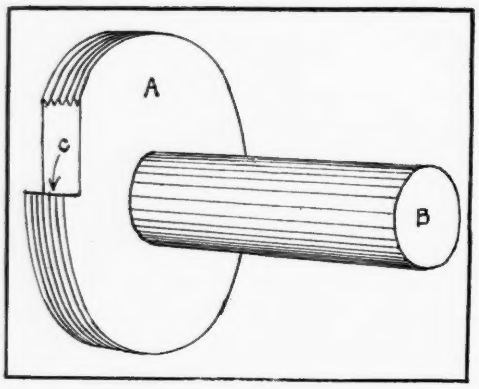


FIG. 3.

like X, Fig. 2, the table is tilted up at its head end (the point opposite the cutter being on a line with the axis of the shaft) and the guide I placed on a slant. To cut a semi-elliptical groove like Z, Fig. 2, the table is tilted as described, while the guide I is parallel to the shaft. By so proportioning the tilt of table and slant of guide a true semi-circular groove can be formed, which permits of a curved semi-circular groove to be made of almost any radius in the following manner: The guide I is removed and two pins are properly placed (position to be found by experiment) and the core box is sawed in a curve, allowance being made for the thickness of wood desired outside the groove. The table being tilted so that the block may pass freely over the top of shaft, and the pins being correctly placed, either to form a semi-circular or semi-elliptical groove, as desired.

To avoid any hand work, except sandpapering, the core boxes should be put over the cutter twice, the second cut making a smooth groove. The cutter, of course, must be kept sharp; otherwise, it will "chew chunks" out of the wood.

Though probably quite old, the chaser illustrated in Fig. 3 seems to be as good as any that can be found, and for all thread cutting of standard pitches is much cheaper and more labor saving than the ordinary diamond point tool. It works equally well on all metals. Its cheapest form is a cutting disk A of tool steel, shrunk on a piece of cold rolled shafting B, the latter of such size as will enter into the tool stock. A thread of the pitch desired is turned on the disk A and the cutting edge C ground in, when the tool is dull the edge is ground again, and ad infinitum, until the thread is all used up, when the cutter is softened, turned off, rethreaded and hardened, and the cutting edge reground, the operations being repeated until the tool will not clear the tool stock. By rounding the last two or three threads, so they cannot cut, and letting them act as the feed, a more accurate pitch may be obtained than by an ordinary lathe lead screw.

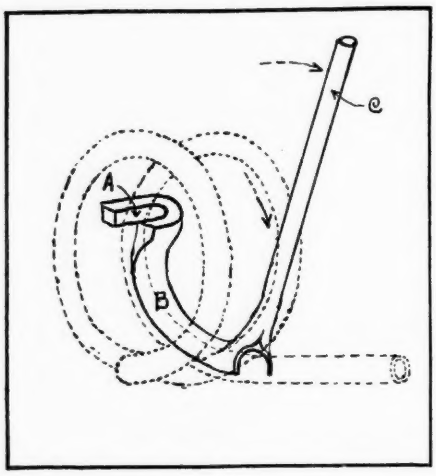


FIG. 4.

Noticing in the October "Machinery" the tale of the fellow who used a shade tree as a mandrel for coiling pipe, brought to mind a simple device (not patented) for that purpose, which was gotten up some years ago by Mr. Harry Welsh, smith foreman of the New Birdsall Co., Auburn, N. Y. As shown in in Fig. 4, it consists of a forging sufficiently strong to withstand the strain put upon it, made up of a slot A, semi-circular groove B, and lever C. The figure is almost self-explanatory, showing the coil in process of formation; the position of the device shows the bend made as far as possible, after which the tool is lifted and slot A slid along the straight pipe when another "bite" is taken. At the end of coil, to bring the curve to the utmost point, a mandrel is inserted in the pipe sufficiently far to enable enough leverage to be obtained. By taking short "bites" and not bending the pipe so close to the groove B coils of larger diameters can be made, being uniformly gauged by a templet.

* * *

The possibilities of electric combination locks for cash drawers and similar receptacles does not seem to have been realized to its fullest extent. It requires but little ingenuity to arrange four or five push buttons in such a way that only one combination will close the circuit of an unlocking magnet, and any other will ring an alarm. The alarm could be placed at any convenient point, and at other points could be placed cut-out switches which, when manipulated, would render it impossible even for one who knew the combination to succeed in opening it. The device is easily developed and marketable.—American Electrician.

DETAILS.

J. H. Francis.

I have often wondered why so few apparently good mechanics make successful erecting engineers. I mean the kind that could be sent out on any kind of a job in the mechanical line, and could look after it to the satisfaction of the owners and his employers; although I must confess that it is rather difficult to satisfy some owners.

One weakness, which proves disastrous to many, is the lack of personal attention to the little details of the job, very often assuming that someone else is attending to this and that part of the work, instead of giving it his own personal supervision. Taking things for granted will very often cause him and his employer considerable trouble, and it may lose him his employer's confidence. I will cite a few cases, showing the damage that may result from neglecting the little things:

One of the young mechanics in our works was sent out to adjust the valves of an 800-HP. engine. This particular engine had a slide valve, with a riding cut-off, each valve having a separate eccentric. After temporarily securing the eccentrics during the operation of setting the valves, the work of securing them permanently to the shaft was left to the engineers, with the result that the cut-off eccentric was not secured, and when the engine was started it refused to turn in its proper place on the crank shaft, causing a serious break-down, owing to the fact that the valve mechanism interfered in some positions.

Now if this young man had personally attended to the tightening up of those two set screws he would have saved himself a great deal of trouble, and also his reputation as a careful mechanic.

Another case which shows how the little things count:

I was instructed some time ago to proceed to a certain New England town to see what could be done in the way of starting an engine that had met with an accident. This engine had been running just one week; in fact, the man who had charge of the erecting was still there. When I arrived at the works I found that the babbit in the main bearing had run into a solid mass, and the man in charge was looking for the person who had thrown emery in the bearings. After looking it over carefully the cause of the trouble was found in the oil chamber. The core sand had not been thoroughly removed and had worked into the bearing with the oil, causing it to heat sufficiently to melt the babbit before it was discovered. Of course, the erector did not find the person who put in the emery, but he found out that the core sand, when properly applied, was just as effective as emery, also that it would be very good practice to examine all oil chambers before starting up.

Then again, you may run across a case similar to the one that was told me the other day:

A friend of mine was called into a factory, where a new engine was being installed. Everything seemingly was in good shape for starting, but when steam was turned on the engine would make a turn or so, then come to a dead stop.

He was assured by the man who had charge of the job that the valves were properly set, and the engine seemed to "bar over" quite easy. After a few more unsuccessful attempts he concluded to examine the valves himself, which he found were all right, as represented, but just before replacing the covers he chanced to look at the exhaust opening, which was not in a very conspicuous position, and found| that someone had placed two pieces of 1-inch board over the opening, completely blocking it, so that no steam could escape from the cylinder. After the boards were removed, and steam turned on, the engine ran satisfactorily.

There was some excuse for the man in charge of this job not discovering the obstruction in the exhaust passage, especially as the opening was in such a concealed position, but I will venture the opinion that all the people interested in that job will make sure when they are erecting engines in the future that the exhaust opening will be free from all obstructions.

When it comes to setting the valves of an engine and using the indicator, then is the time to take care of the little things, and unless you are prepared to do so you might as well throw your indicator away, as the cards taken with an indicator carelessly connected and used, are very liable to be worse than useless.

I visited a small town a few weeks ago to see if it was possible to get a proper looking card from an automatic cut-off engine that was running in a flour mill. There had been two or three parties on the job before I arrived there. I judged from the cards that were shown me that the valves were not properly set, so I decided to look them over the first thing, of course, expecting them to show up something like the cards; but after turning the engine over a few times and finding that the valves and cards did not correspond, I concluded to look elsewhere, and finally located the trouble in the reducing motion apparatus that they had been using. After correcting this the cards were as good as could be expected from that type of an engine. In conclusion, my advice to any young man who is placed in charge of work of this character is to assume that everything about the job is wrong until he proves that it is right. Even the work from his own shop should not be above suspicion. Examine all parts carefully, and make sure they are right before placing them in position. Before starting a new engine see that there is a supply of good oil on hand, for the bearings and cylinder. It is an easy matter to ruin them at the start with poor oil and lack of attention. Do not economize at this stage of the proceedings. Later on, when the bearings are in good running condition, you can gradually let up on the oil question, but for the initial start get the best you can and see to it personally that all the parts are thoroughly lubricated.

* * *

ABOUT GRINDING MACHINES.

A book recently issued by the Landis Tool Co., Waynesboro, Pa., upon the use and construction of grinding machines, calls attention to the extreme accuracy of the grinding machine in the detection of error. Anyone who has operated this machine, or watched one at work, is familiar with the fact that there is a very perceptible variation in the sparking of the wheel, even when the piece is nearing its finished size, and many consider this to indicate that the work is very much out of true. As a matter of fact, however, it is stated that an error of less than one-fiftieth of one-thousandth of an inch, or so small as not to be detected by an indicator, may readily produce an appreciable difference in the sparking, thus making the grinding machine the most sensitive detector of error of any iron-working machine in existence. If, as is usually the case, the finishing cut shows a uniformity of sparks, there can be no question but that the work is well within the limits required by the best shop practice. It is further said that in grinding a shaft, say one inch in diameter, if it first be ground absolutely true, so that it sparks evenly, using water, and then the finger be held on one side of the shaft for a short time, it will impart enough heat to it to change the axis so that in grinding again the wheel will cut on one side of the shaft only. While the amount of change from this cause must be very slight, it may appear to be considerable through the variation in the sparking.

Another interesting point that is mentioned relates to the importance of wet grinding. A slight increase of temperature on one side of a shaft in excess of the other will change its axis very much more than the amount of the expansion. If work is heated more on one side than on the other, due to a heavier cut, that side will spring against the wheel and cause it to grind still heavier and heat and spring still more. As the stock is removed, however, the heat will equalize itself in the shaft until the axis returns, when grinding will take place on the opposite side, and thus there will be a continual movement of the shaft back and forth, and true results can be obtained only with the exercise of great care. The only satisfactory way is to use plenty of water and keep the work cool.

* * *

We are not informed as to the "staying" qualities of powder, but a Cleveland correspondent has sent the following item, which, if correct, shows that the British can safely be credited with the last shot in the war of 1812: "Some shells fired ashore by a British warship have been preserved as relics. Some time ago one of them accidentally got into a pile of scrap iron which was delivered to the Phoenix Iron Works. It went into the furnace with the rest of the scrap iron and a terrific explosion followed, blowing the furnace doors to atoms. Fortunately the workmen were all at work in other parts of the foundry at the time."

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DECEMBER, 1898.

From time to time Machinery will solicit articles upon live topics from men who are qualified through training and experience to express opinions upon them. When these articles are substantially in accord with the editorial policy of the paper, they will be used in the form of a signed editorial upon the editorial page. This month we are pleased to publish such an article from Prof. John E. Sweet.

* * *

THE METRIC SYSTEM.

Twenty years ago a pestilence of serious magnitude threatened the industrial activities of the country. It originated at the intellectual centre, was disseminated by virus sent broadcast through the educational channels, glistened in the eyes of the learned doctors like stars in the firmament; and could it have been seen by the popular millions that were to be affected by it, it would have been a lowering cloud. Just before the day of dawning there appeared a man, a giant, who, by one stroke of the pen (an essay of twenty minutes' length), hurled the pestilence back. It disappeared and was buried for fifteen years. That pestilence was the Metric System; the essay, a paper read at the first meeting of the American Society of Mechanical Engineers; and the man was Dr. Coleman Sellers, who, by this one act, did more for the country than any other one man during that fifteen years.

The pestilence is again threatening the country, but this time it is a canker gnawing at the nation's heart. There is a bill before Congress proposing to make the Metric System the only legal standard of weights and measures. This law ought not to be enacted, because it cannot be enforced, and a people who disregard obnoxious laws become indifferent to good ones. The law ought not to be enforced, ought not to be obeyed, because the proposed system is not as good as our present one. It would impose a great burden upon the many millions who could not by any possibility receive any benefit from it, if it was ever so much better, and the million or say two millions at the utmost, who would be benefited by it, would have to shoulder none of the burdens whatever.

Its advocates claim the Metric System to be scientific and more convenient. It is true that it was devised by a board of scientists, but utterly fails to justify its claim to be scientific,* and as to its convenience—that is only true so far as relates to mathematical calculations. The mistake was made when the matter of its evolution was entrusted to a board of scientists instead of a board of men who knew something about weighing and measuring in the industrial and commercial sense.

The Metric System is an ideal one so far as mathematical calculations are concerned, an ideal system for the man who deals in ideas; but history and experience show it to be the reverse of convenient in the practical uses of life. The decimal system was in the beginning and will be to the end, the method of notation, still kept up by those nations who neither weigh nor measure, but every civilized nation, in the development of its industries and commerce abandoned the dividing by ten and adopted the biennial system. Whether a bushel, a stone, a pound or a yard they divided their unit into halves and quarters and eighths, and it is so with us to-day, even with our boasted money system; we divide our dollar into halves and quarters, and so long as we had the coin to represent them stuck to the York shilling and sixpence. When we were forced into using the dime, we cut that in two with a nickle, and though mills are in the law and the books, no one uses them. The men on 'Change, our merchants and the sportsmen cut the cent into halves, and quarters, eighths and sixteenths; this is the best thing to do, and the natural thing to do, because it is the best. No rule or scale-beam ever graduated, is or can be as easily or reliably read if divided into tenths, as in halves, quarters and eighths; nor is it possible to construct a rule or square on the metric system comparable as a tool to the two-foot rule of the machinist, or the steel square of the carpenter.

When the nations began to emerge from barbarism, and began to use and deal in weights and measures, each worked out units of their own. In lineal measure a comparison made by Mr. Partridge† showed nearly all had one unit very nearly like the English inch, and another like the English foot, which shows (if any such evidence shows anything) that they are natural units, and with which there is nothing in the metric system corresponding. Further evidence that the inch is a natural unit is the fact that all tables of French sizes, such as tools, bar stock, pipes and things of that kind, conform as near to the inch and its multiples and sub-divisions as is practical with a unit not commensurate.

The advocates of the Metric System, failing to show that it is based on any scientific ground and abandoning the argument that it is either a natural or convenient one to use, still have the claim that it is to be the system of the world, and that it has already been adopted by all nations but England, Russia and America. The advocates in Russia say that England and America are falling into line, the advocates in England say that Russia and America are falling into line, and the advocates here tell the same story about England and Russia. They leave out two important facts in their representations—that the three countries mentioned are a good half of the civilized world, and that people using the English unit do as much weighing and measuring as all other people aspiring to accuracy put together. Again they assume or carry the idea that all the people of the countries whose governments have legalized the Metric System use it. This is not half true! No nation uses it exclusively, not even the French. In the workshops of Belgium and Sweden, two progressive nations, both the English and French systems are used extensively, and the cost of double sets of all sorts of tools and gauges is, and always will be imperative. In some of the countries scarcely more has been done to establish the metric system than was done here more than a third of a century ago—the enactment of a law making the metric a legal system of weights and measures.

Allowing that all the advantages claimed for a universal system exist, it would be much easier for the nations now using the Metric System to change to the better English one, as they

* As shown by the eminent engineer, Charles T. Porter, in a paper published in "Locomotive Engineering."

† In a paper read before the American Society of Mechanical Engineers, in 1881.

will in time to the English language, because, half of them already have the English measures, using them still to a considerable extent; and the change, if worth while at all, would be easier. Why the nations who had no standard of their own adopted the Metric System in place of the English was because it was settled by the men who use the pencil rather than those who do the weighing and measuring.

As an evidence that the manufacturers in this country do not favor it—letters of inquiry were sent out to about seventy of the leading manufacturers, and of over forty replies received, only three favored it, one or two allowed that they would adopt it when compelled, and the rest were utterly opposed to it, and would not adopt it, and yet nearly all these manufacturers are doing a large foreign trade. Whoever will take the trouble to investigate will at once conclude that the cost, as stated by Dr. Sellers, as "millions upon millions," is not overestimated. The cost affects all industries from the few dollars of the farmer to the tens of thousands of the manufacturer, and what will it save? A lot of figuring claimed by its advocates! While, as a matter of fact, for a time in many cases the figuring will be multiplied ten-fold. All drawings will have to be made anew, or refigured; all tables changed, the engineers' private notes translated; all the constants in formulae will be wrong; records for estimates will have to be corrected, and worst of all every book now printed in the English language, where reference is made to weights and measures will need to be translated by posterity before they can get a realizing sense of the magnitude of the thing mentioned. What a blessing to posterity, who, it is claimed, are to be the greatest beneficiaries.

A lead pencil will figure just as well in the Metric System as in ours, but the reformers in this case, as is usual, seem to hit upon a plan that puts the burden and bother of the change on other people, and none upon themselves.

JOHN E. SWEET.

* * *

A SLABBING TOOL.

A. H. CLEAVES.

The accompanying device was used at the National Time Recorder Company, Chicago, for sizing square German silver rods and worked accurately and quickly.

In Fig. 1 and Fig. 2 A is a casting with a projecting base, for securing the former to the drill-press bed and B is a cap piece for A.

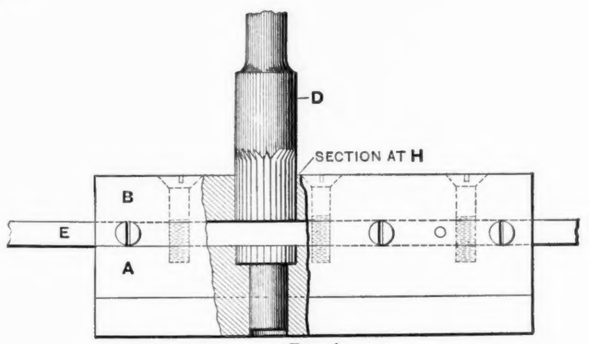


Fig. 1

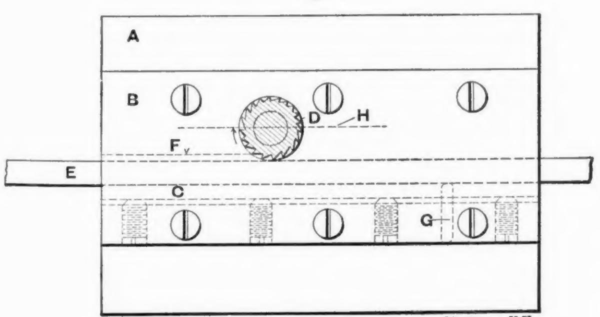


Fig. 2

The stock E enters the opening of the jig at F, which is wider here than beyond the cutter D. The cut for two sides is first made, being gauged by the gib C, held every way by the pin G. Set-screws get the adjustment as shown.

E is pushed through the jig for a start, then caught with a hand vise or clamp and drawn clear through against the edge of cutter D; the edge of the teeth on this cutter being flush with the side of the opening opposite the gib, and back of itself.

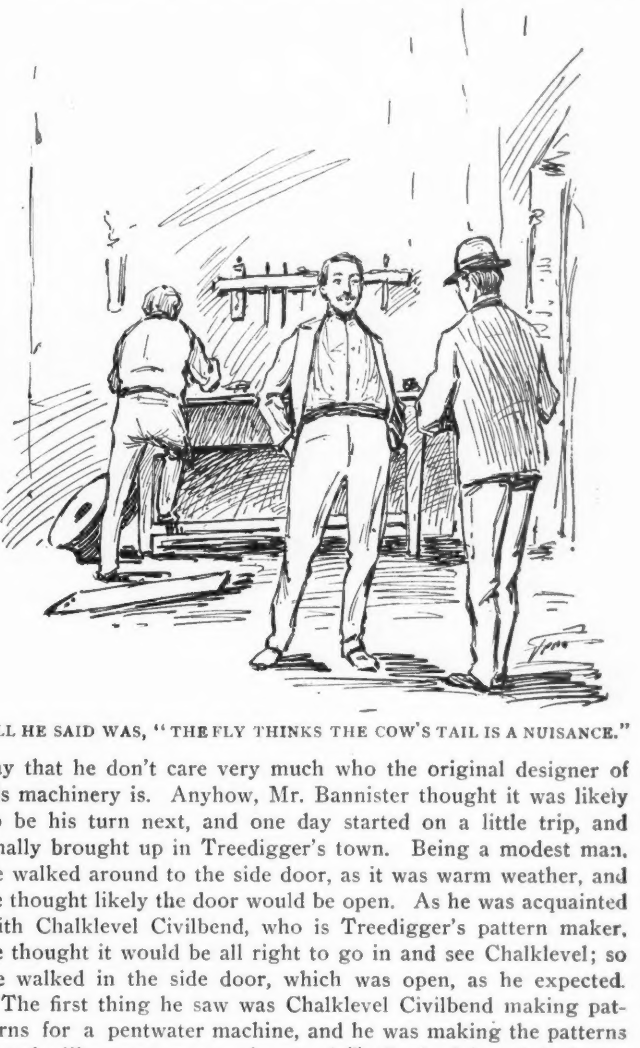
When two sides of the stock are dressed off, the gib is set up further to dress the other two sides, and the side of a rod ten or twelve feet long runs within a thousandth for gauge.

The casting A is fixed, and D runs in the drill-press, guided by openings in A and B.

* * *

WHAT SHALL WE DO TO KEEP FROM BEING SHAVED?

Trolleybrain Bannister is a manufacturer of pentwater machinery, and has made a sort of specialty of this particular branch, and Treedigger Tredennick is another manufacturer of machinery, but makes any old kind that he can sell, and some people



ALL HE SAID WAS, "THE FLY THINKS THE COW'S TAIL IS A NUISANCE."

say that he don't care very much who the original designer of his machinery is. Anyhow, Mr. Bannister thought it was likely to be his turn next, and one day started on a little trip, and finally brought up in Treedigger's town. Being a modest man, he walked around to the side door, as it was warm weather, and he thought likely the door would be open. As he was acquainted with Chalklevel Civilbend, who is Treedigger's pattern maker, he thought it would be all right to go in and see Chalklevel; so he walked in the side door, which was open, as he expected.

The first thing he saw was Chalklevel Civilbend making patterns for a pentwater machine, and he was making the patterns exactly like some parts of one of Trolleybrain's original machines, which were strewn around the pattern room floor.

"The camel thinks his hump is a thing of beauty," and of course Trolleybrain thinks his machine is the handsomest shaped machine in the world, to say nothing of the fact that he was the inventor of the machine, and he thought it was bad enough for Treedigger to steal the invention, without stealing all his shapes and sizes as well. He therefore began to get hot under the collar, and when Treedigger came in shortly after, Trolleybrain told him what he thought of him in language which had many interpolations of a theological character, and told him he was the meanest man in the business, and an all-around nuisance.

Maybe you think that Treedigger got mad? Not at all. He was used to such incidents, and simply laughed at Trolleybrain, and all he said was: "The fly thinks the cow's tail is a nuisance." What is to be done with these fellows that are so busy stealing other people's inventions and designs, that they have no time to get insulted? If any of our readers have any ideas on the subject, please send them in.

SLOW PAY.

* * *

Small things in the aggregate amount to unexpectedly large proportions. Pennsylvania and Michigan alone are said to produce 3,000,000 clothes pins a day, which are made chiefly of beech wood.

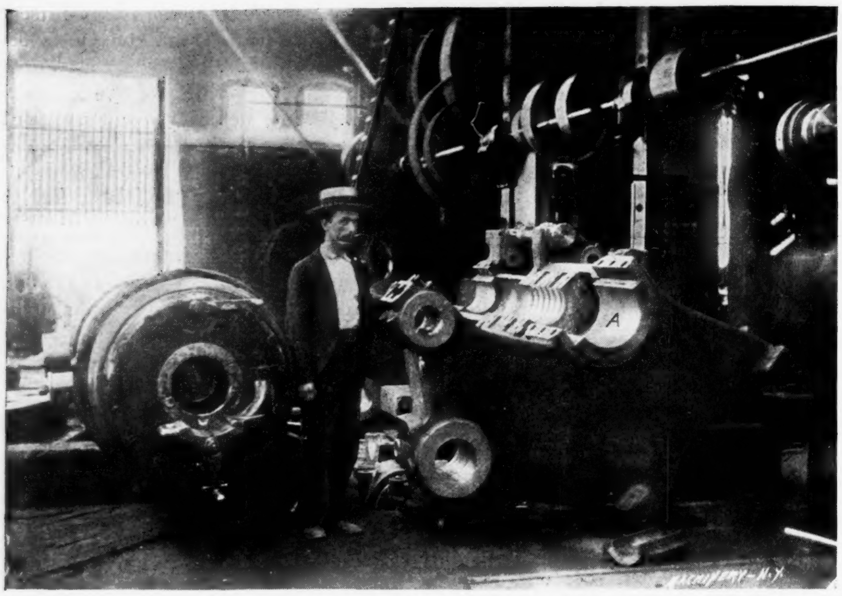


FIG. 1. HEADSTOCK OF A GUN LATHE.

NOTES FROM THE NILES TOOL WORKS.

The photographs reproduced with these notes were taken at the Niles Tool Works, in Hamilton, Ohio, and illustrate the heavy nature of the machine tool building done there.

Fig. 1 shows the partly finished headstock of a large lathe, similar to those used in making Uncle Sam's heavy guns, which speak only when they are obliged to, and then right to the point; this trait being so conspicuously displayed during their recent dispute with their Spanish opponents that their reputation is very thoroughly established. The photograph includes one of the workmen with his back towards the breech of a 10-inch rifle, and gives a fair idea of the general proportions, but the dimensions of the main bearing A in the headstock, which is 14 x 21 inches, are a little more definite.

The end thrust of the spindle is taken on a series of rings that fit in the grooves in the headstock between the two bearings, which is one of the differences between this headstock and those on small lathes. It looks almost left-handed to one who is accustomed to small lathes only.

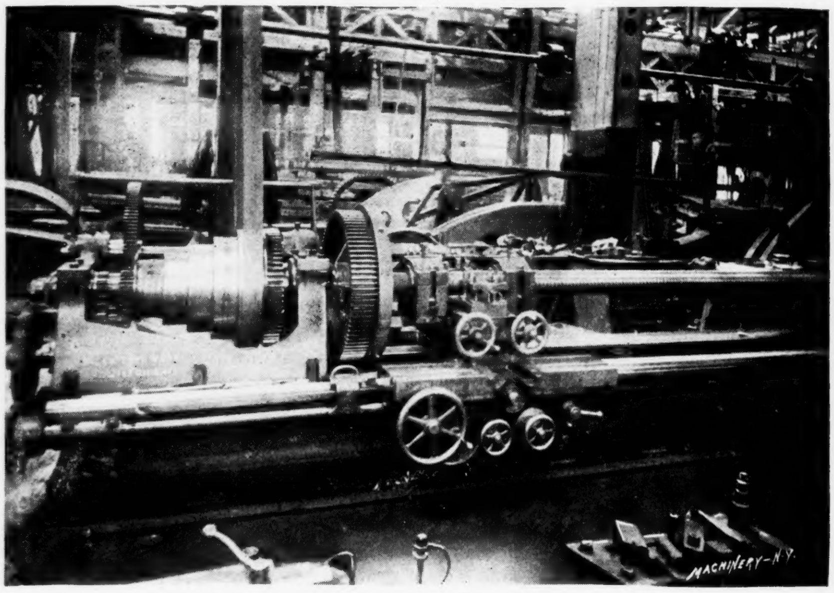


FIG. 2. CUTTING A LARGE LEAD SCREW.

The cutting of the thread on the lead screw for the lathe is shown in Fig. 2, but the shops were so filled with work that only a fraction of its length could be included in the photograph, it being 54 feet long, 6 inches in diameter, and 1 inch pitch. The longest screw previously made was six feet longer and one-half inch larger in diameter.

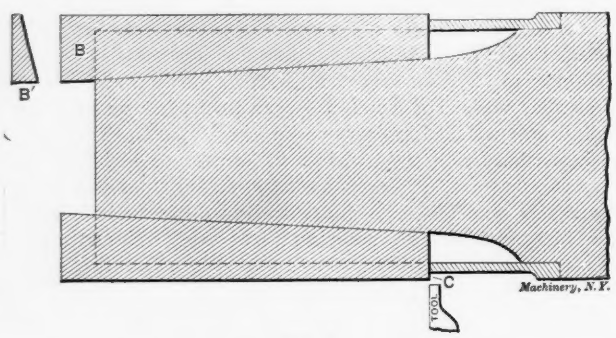


FIG. 5.

In one of these shops a large boring mill was being erected, and the "spider" that was used to index the teeth for the large gear of 164 teeth 1 inch diametral pitch, was photographed as it stood with one edge resting on the floor and the other against the gallery floor 14 feet above. It is not very common to see cut gears of this size, but it is the practice here, a formed tool being used in a large slotting machine to plane the teeth. A 16-foot wheel could be turned on this mill with the housings to the front, but by running them back it will swing work 25 feet in diameter.

A visit to these works would repay any mechanic who has the opportunity to make it, and more interesting photographs could have been secured had they not been so crowded with a general rush of work, which included a lot of large mortars for the United States Government.

Some idea of the equipment of this large and well known establishment can probably be given by mentioning one of the planers, which has a capacity for work up to 12 x 12 x 30 feet, and the supply of reamers, which is considered as quite unusual, and ranges by $\frac{1}{16}$ of an inch from $\frac{1}{4}$ of an inch to 10 inches in diameter, with some special reamers between these.

My attention was called to the construction of one type of these reamers, which is adjustable, yet solid, and is illustrated in Fig. 5.

The body of the reamer is slotted to receive the blades B,

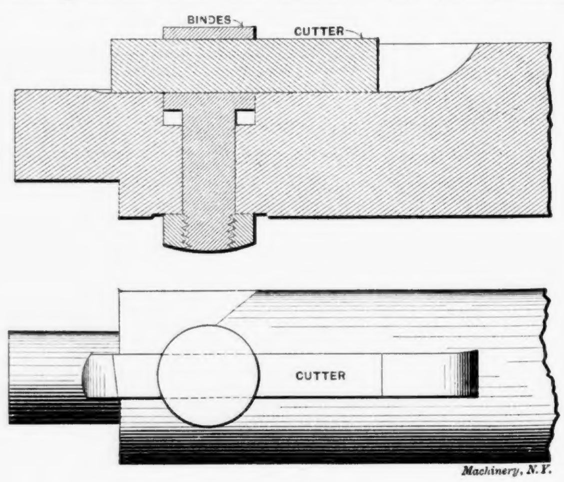


FIG. 6.

which are driven in quite tight and ground in place like a solid reamer. The bottom of the slots farthest from the end of the reamer are at a greater distance from the center than they are at the end, so that when the reamer becomes dull

the bushing may be cut away at c with a parting tool and the blades driven up against it again, the inclined bottom of the slot forcing them away from the center sufficiently to allow regrinding to the original size. From the cross-section of

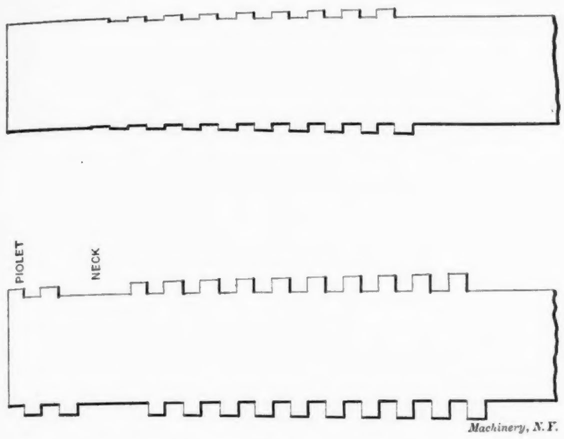


FIG. 7.

the blade, shown at B′ it will be noticed that the slots are cut in, straight towards the center, and in widening them out at the bottom the stock is taken from one side only.

Fig 6 is so plain that words are unnecessary. It illustrates the construction of a counterbore, with inserted self-hardening

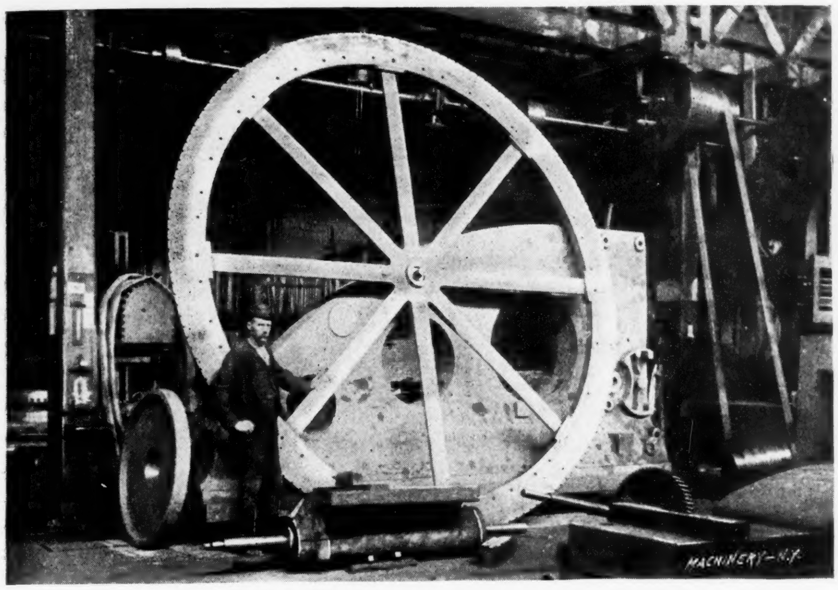


FIG. 3. THE 16-FOOT SPIDER.

steel cutter, and is so easily kept in condition that I deem it worthy of mention here, although it may not be particularly novel.

Another practice which they seem to be pleased with relates to their square thread taps. There are usually four taps in a set and each has a pilot on the end to guide it, the pilot on the first one being smooth to fit the hole to be tapped, and on those that follow the pilot correspond to the partly finished thread made by the preceding tap. A little study of the sketch in Fig. 7, which shows the outline of a set of two taps, instead of four, the two intermediate taps being omitted in the sketches for the sake of clearness and economy of space, will make the matter plain I am not sure that there was a nick on the first tap between the pilot and the teeth, but there was on those that followed it. Fig. 8 is submitted as a continuation of the subject of wooden back calipers, by Mr. Snow, in the October number. The frame in this case, however, is stiffly made of tubing, but in other respects is practically the same as those described by Mr.

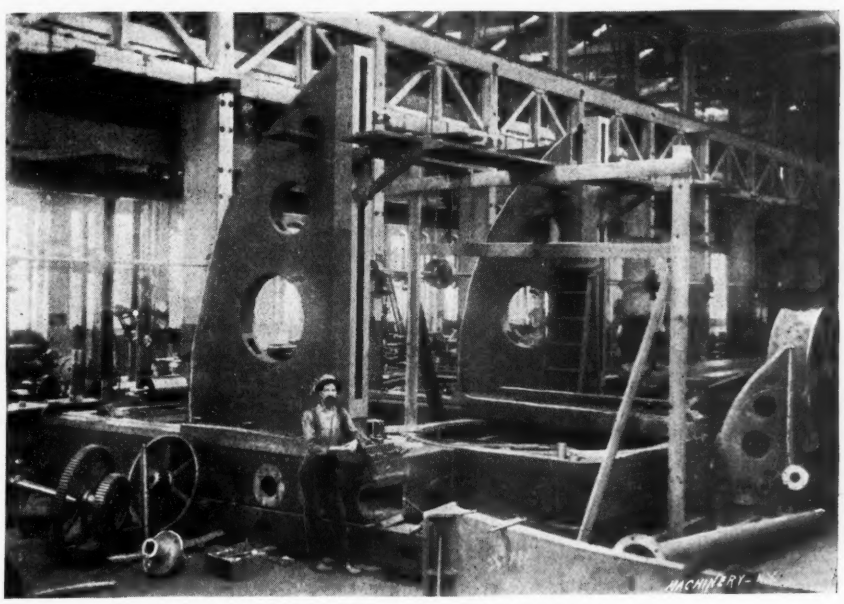


FIG. 4. ERECTING A 16 X 25 FOOT BORING MILL.

Snow. The original was a very neat tool found at the Niles Tool Works, and the sketch, like those that precede it, has been made from memory. A. L. G.

* * *

The polished sight-feed lubricators that are used on nearly all classes of steam engines give a finished appearance to the ma-

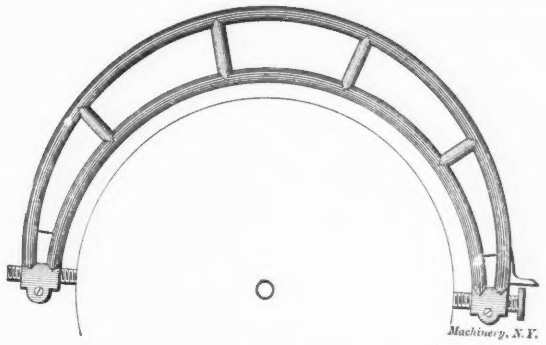


FIG. 8.

chine and serve their purpose very well as long as they are carefully looked after. We have heard the opinion expressed, however, that they really have no place in the most advanced design and that they are simply the last end of the line of ornamentation that includes piano planer legs, brass bands around the locomotive boilers and cylinders, and the striped ornamentation that the painter still gives to some classes of machinery. While we cannot agree entirely with this view, the tendency undoubtedly is and should be to make the oiling apparatus an integral part of the machine. It is difficult to see how the average double acting steam engine cylinder could be oiled without the sight-feed indicator, and certainly nothing could be more efficient and at the same time economical. But in the case of the various bearings the conditions are different. Undoubtedly the best and safest way to oil them is by having the bearings so enclosed and protected that they can be continually flooded with the lubricant from a central supply tank, or splashed with oil by the movement of the crank and connecting rod through a body of oil and water at each stroke, as in the Westinghouse and some other makes of engines. When either of these methods is employed, it would be in keeping with modern ideas to have the lubricating system incorporated in the general design of the engine, instead of separate from or in addition to it, as though it were an after-thought. In direct-connected work this is almost a necessity for the protection of the generators.

SHOP TALKS WITH YOUNG MECHANICS—10.

MILLING CUTTERS.

W. H. Van Dervoort.

The milling of metallic surfaces requires a rotating cutter provided with one or more teeth having an edge and temper suited to the nature of the material operated upon. As to construction, milling cutters may be divided into the two classes—solid and inserted teeth. All small and most of the medium sized cutters may be brought under the first class, as they are made from a single piece of tool steel; but when the dimensions become large the cost of the steel is an important point, which, together with the risks incident to the proper hardening of such large masses of tool steel, warrants the greater expenditure of labor usually necessary in the making of inserted tooth cutters. The inserted tooth cutter has only teeth of tool steel, the core or body being of cast iron or mild steel.

As to classification, milling cutters naturally fall under four heads, as determined by the four distinct varieties of work performed, as follows: Axial—those cutters used for milling plain surfaces which are parallel to the axis of rotation of the cutter;

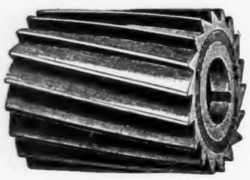


FIG. 166.

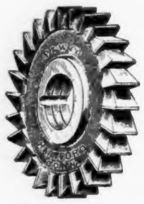


FIG. 167.

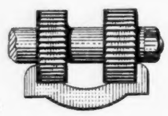


FIG. 168.

Radial—those which will plane surfaces at right angles to the axis; Angular—those used in milling plain surfaces at any angle other than 90 degrees with the axis, and Form cutters, used for machining all curved or irregular surfaces.

In Fig. 166 is shown an axial or plain milling cutter, as it is usually called. It has teeth on the cylindrical surface only, which, when the cutter exceeds about one-half inch in thickness are cut spirally, as shown in the figure. When these cutters are less than three-sixteenths of an inch in thickness, they are called metal slitting saws, and the sides are ground slightly dishing, which serves to give the teeth clearance in the grooves they cut. This is of much importance when the cut is deep, as is frequently the case when using the metal slitting saw.

The spiral teeth on these cutters are necessary for the following reasons. If the teeth were straight, each tooth as it comes into action would strike square against the work, producing a shock and consequent springing of work and cutter arbor; and

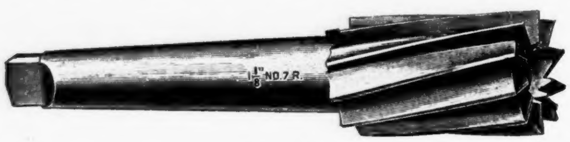


FIG. 169.

as each tooth leaves the work the sudden release of pressure causes reverse spring. If the cut is not deep, and only one or two teeth cutting at a time this effect will be more marked than when a greater number of teeth are in action, and the effect of the spring will be clearly shown by the waved and uneven condition of the surface produced. If, on the other hand, the teeth are arranged spirally they will come into and leave the work gradually, thus avoiding shock and, what is very important, give a shearing cut.

When provided with teeth on their faces, these cutters become what are called radial, face, side or straddle mills. When the teeth are on but one face and the cutters used for straddle work, they must be cut right and left, as otherwise one cutter would run backwards. The cutter shown in Fig. 167 can be run in either direction, as it has teeth on both faces, and constitutes the form usually used. These cutters, when worked in pairs, and especially for shoulder work, as shown in Fig. 168, should be carefully ground to the same diameter.

The end or shank milling cutter shown in Fig. 169 is virtually a radial mill of small diameter provided with its own independent shank. These cutters are seldom made larger than 1½ inches in diameter. Their form permits the small diameters, which are so necessary in much of the fine milling work. These cutters are made right and left handed, and frequently the teeth on the circumference are cut spirally, as shown, straight teeth, however, being most used. The advantage of the spiral tooth for the end mill when used as an axial cutter arises from the decreased shock and vibration due to the steady shearing cut, which reduces the tendency of the tool to jar loose in the spindle or collet bearing. The direction of the spiral must be such

FIG. 170.

FIG. 171.

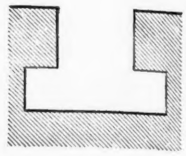


FIG. 172.

that the end thrust of the cutting pressure tends to force the shank into, rather than draw it out, of its bearing. In a right-hand mill the angle of the spiral would be left-handed.

If it is desired to mill a slot with the end of the shank cutter, shown in Fig. 169, which does not start at the edge of the work, a hole must be drilled into the work of a diameter at least equal to the diameter of the space without teeth in the end of the cutter, as otherwise the cutter could be made to enter only a depth equal to the depth of this space, and could not then be moved along the work. A form of cutter shown in Fig. 170 overcomes this difficulty, as the inner ends of the radial teeth are provided with cutting edges, which enables them to cut their way out when moved along the work. The length of these cutting edges limits, however, the depth to which the cutter may be made to enter

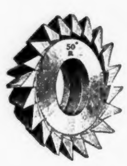


FIG. 173.

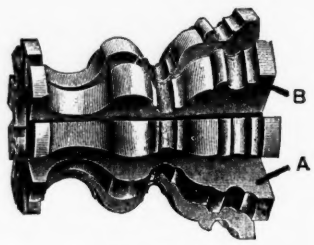
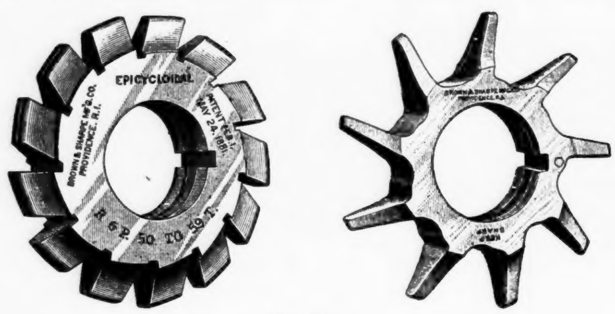


FIG. 174.

the work at any one setting. In this form of cutter a smaller number of teeth must be used. The end mill may be placed under either of the two first classes, as it may be used for machining surfaces which are either parallel with or at right angles to the axis of rotation.

The standard T-slot cutter is shown in Fig. 171. This tool is used in cutting the slots, a section of which is shown in Fig. 172, the central portion of the slot having been previously removed. In the cutter shown, alternate teeth cut on the inner and outer edges. These face teeth, however, have little work to do, and are on some cutters omitted, the faces being ground slightly dishing, to provide the necessary clearance. T-slot cutters are made 1-32 of an inch over size in diameter, to allow for grinding. They are usually made left-hand, as shown in the figure.



A. FIG. 175. B.

In Fig. 173 is shown an angular cutter. These cutters are usually provided with face teeth, as shown in the figure. For straight work the face teeth may be omitted, the face being

ground slightly concave. When the character of the work requires the cutter to be used as an end mill, a threaded hole is substituted for the plain one and the cutter held on the end of a suitable screw arbor. These cutters are regularly made with 40, 45, 50, 60, 70 or 80 degree angles, either right or left-handed.

In all of the cutters above referred to, the teeth are sharpened by grinding from their top edges, and since the surfaces milled are either planes or warped planes, the contour of the surface milled is not changed by so grinding the cutter. In form milling, however, the teeth, if so ground, would lose their outline and would therefore not produce correct work after being sharpened. This difficulty is overcome by the use of the formed cutter, an example of which is shown in Fig. 174. This cutter is sharpened by grinding from the front face, A, of each tooth. The cross-section of each tooth is the same from front to back faces. The back face, B, being somewhat nearer the center of the cutter than face A, provides the necessary tooth clearance. The sharpening of this cutter simply reduces slightly its diameter, which has no effect on the contour of the machined surface, the cutter being adjusted for depth after each grinding.

The original application of this method of forming the teeth was on gear cutters, but it has since been adapted to nearly all classes of irregular outline cutters used for form milling. Fig. 175 shows at A a new gear cutter and at B a similar cutter, which has finished complete, at one cut in cast iron, gear teeth aggregating a total length of 7,472 feet, the necessary grinding to keep the cutter in proper working condition having reduced the teeth to the shape shown in the figure. The last tooth cut was, however, quite as accurate in form as the first.

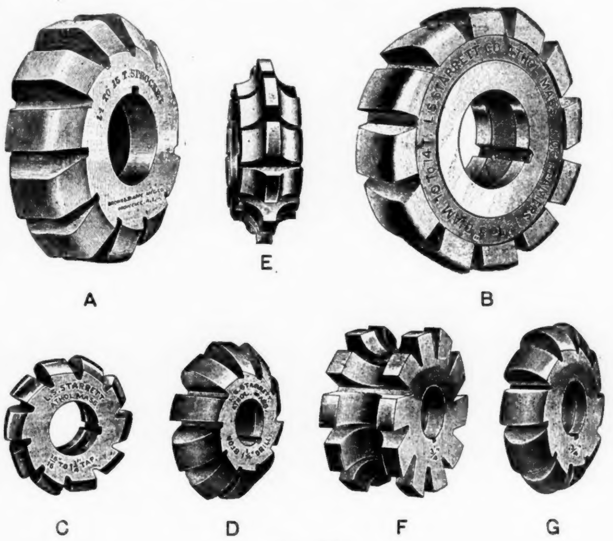


FIG. 176.

In Fig. 176 is shown a group of formed milling cutters. The names of these cutters, as given below, refer to the special class of work each is designed to perform. A is a sprocket wheel cutter; B, cutter for fluting reamers; C, for grooving taps; D, for cutting twist drills; E, circular cornering cutter; F, concave cutter, and G, a convex cutter. The hob cutter, Fig. 177, used for cutting the teeth of worm gears, has formed teeth. Angular cutters with formed teeth, Fig. 178, are now quite extensively used. They are the only cutters regularly made with formed teeth that are used on work not classed under the head of form work.

The method by which the relieved teeth are produced is briefly outlined in the following. The cutter, which is to form the teeth is an exact negative in outline to the outline of the required tooth. The form of the space required is very carefully laid out with a fine scriber on a piece of smoked sheet zinc. The zinc is then cut away, forming a template, to which the cutter is carefully fitted; the final fitting of the cutter to the template being made by oil-stoning after it is tempered. This work requires the best of skill, and when a cutter is once perfectly formed, other cutters may be made from the first milling cutter it produces. These cutters are made on the end of a bar of steel and are as thin at the cuting end as strength will permit their being made.

Take, for example, the gear cutter A, Fig. 175. It is first blanked to nearly the exact dimensions, the spaces which separate the teeth cut and the blank secured on a rigid arbor, which is driven in a special machine at a slow rate of rotation. In front of the blank is mounted the outlining cutter in such a manner that it is given a small in and out motion once per revolution for every tooth to be cut. When the cutter begins to cut at the face A, it is farthest from the center of the blank, and as the tooth advances to the face B, the cutter moves towards the center, thus cutting the tooth deeper at B than at A. While the blank is turning through the space to the next tooth the cutter backs quickly to its outer position and repeats its motion for each tooth, until all are properly formed.

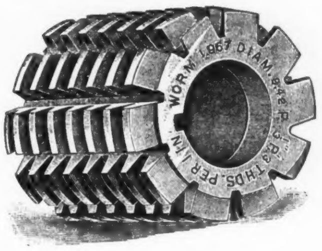


FIG. 177

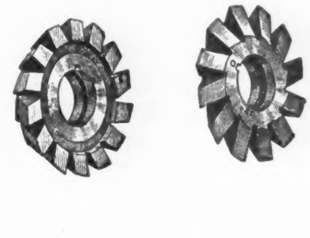


FIG. 178.

Relieved tooth cutters are made from solid stock as large as seven inches in diameter and six inches in length. It is usual to make these large cutters in sections, as shown in Fig. 179. Such combinations of cutters are termed gang mills, and may frequently be made up largely of standard cutters. In the one shown, only the middle section is a formed cutter, the balance being regular stock cutters.

What is known as the fly cutter is the simplest of the formed mills, and makes a cutter well adapted to small jobs of special work, where the expense of a regular form cutter would not be warranted. The fly cutter consists of a single tooth mounted in an arbor. In making the cutting tooth the stock is set slightly back from the center, and is then turned in a lathe to the desired, outline, tempered and reset in the arbor, this time with a liner behind it, which throws it forward until the front face comes radial, and gives the tooth the desired clearance.

As already indicated, the inserted tooth is virtually the only practical method of making very large milling cutters. The principal difference in cutters of this class lies in the form of tooth and the method of securing it in the head. Inserted tooth cutters necessarily have fewer teeth per inch of circumference than solid cutters. This, however, is considered by many as an advantage. It certainly is on some classes of work, as when too many are used the cut per tooth is too fine, the metal being scraped rather than cut away, which produces excessive friction with a tendency to glaze the surface and rapidly dull the cutter.

In Fig. 180 is shown a form of axial milling cutter, which is used for heavy slabbing work. It is made in any required size and constitutes a very efficient tool for heavy work. The teeth are round pieces of tempered steel driven firmly into the soft core, and then ground in place. It is found that cutters of this class do smoother and better work when the teeth are irregularly spaced. A radial mill constructed along these same lines is shown in Fig. 181. Here the teeth are held in position by set screws, and may be adjusted out when much worn. A plain disk may be substituted for the armed head, the set screws put in the back and more cutters used if desired. The cutting edges

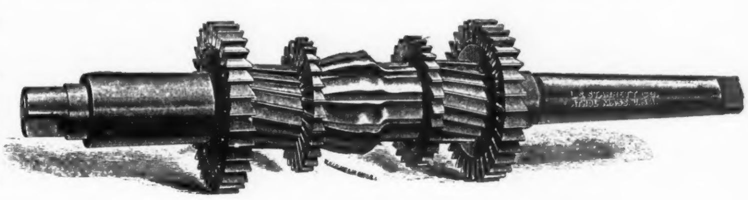


FIG. 179.

of the teeth should project beyond the circumference as well as the face of the disk. Cutters of this character are frequently made of very large diameter.

Fig. 182 illustrates a pair of inserted tooth plain mills, in which the teeth are nicked, the claim for this being improved lubrication of the cutting edges over a plain straight tooth. The teeth are arranged spirally, and the method of securing them in the heads is apparent. The makers of this cutter also make plain solid milling cutters with the divided tooth.

Fig. 183 shows a pair of mills, quite similar in construction, in which the tapered pins spread the stock an amount sufficient to grip firmly the teeth. In the cutter shown in Fig. 184 the teeth are pinched in their seats by drawing down with the screws the tapered bushings.

The inserted tooth is well adapted for use in cutters that must be kept up to fixed dimensions, as the teeth when dull can be set out and reground to the exact required dimensions.

The diameter of a milling cutter should be as small as the work will permit. The small cutter requires less power to drive

FIG. 180.

it, cuts smoother, keeps sharp longer, makes its cut on a shorter length of feed than a large cutter, and is lower in first cost. Plain or axial cutters can usually be of small diameter as the cut is seldom deep, and the surface machined requires length rather than diameter of cutter. This is, however, reversed in the face or radial mill, where the diameter of cutters depends entirely on the width of the surface to be milled.

Milling cutters are usually made with the front faces of the teeth radial, thus giving no angle of rake. The angle of clearance should be about 3 degrees; the width of the top of the tooth being, before the first grinding, from .02 to .04 of an inch wide.

FIG. 181.

FIG. 182.

Too much stress cannot be laid on the importance of keeping milling cutters sharp, and especially the formed cutters. When a cutter starts to dull it begins to crush and remove by abrasion rather than cut the stock. This produces excessive friction between the teeth and work, and unless the cutter is ground promptly, its edges will be entirely lost. In the case of a formed cutter, when dull, a few revolutions will often so badly snub the teeth that a fourth or even more of each tooth will be ground away before their perfect section is reached. This is a tedious process, and unless great care is exercised is very apt to result in destroying the temper on one or more of the teeth.

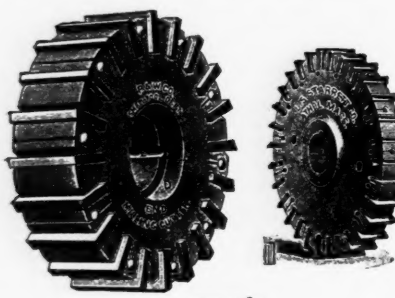


FIG 183.

FIG. 184.

The grinding of formed cutters requires an emery wheel of thin dished section with a straight face at the edge. The tendency is to grind too much from the outer part of the tooth face, thus making a negative rake angle and poor cutting teeth. For grinding the ordinary form of tooth, a thin wheel of quite large diameter should be used. If the diameter is small the top of the tooth will be ground concave to such an extent that the cutting edge would be materially weakened. By so mounting the wheel that its axis is not parallel with that of the cutter it will grind the top of the tooth flat. This is not ordinarily done, however. The emery wheel used for this purpose should be a free cutting one, and not too fine, as a fine wheel glazes and turns the delicate edge of the tooth. Its grinding face should be thin, and the emery about No. 80.

* * *

NEGLECTED POINTS IN FUEL CONSUMPTION AND DRAFT.

W. H. Booth.

There are certain facts forced home to our understanding that become engraved on the mind. We do not, perhaps, realize that the facts influence our judgments in things mechanical until we have our attention particularly directed upon them. In the combustion of fuel there are many such facts which, noticed from time to time, we come to look on as axioms, for we observe that to run counter to them leads to loss. In my own experience I have observed that there is a close relation and interdependence between the dimensions of the individual pieces of fuel, the thickness of the bed of fire, and the power or intensity of draft. Let it be supposed that a certain fuel is being used upon a grate 4 feet in length. If the fuel be reduced in size, it would not be found possible to keep up steam unless the grate was lengthened perhaps to 5 feet or even 6 feet. At the same time the power of the draft would be found to be insufficient to draw air through the same thickness of fire as formerly, and, in place of 9 inches, perhaps only a 5-inch fire could be carried.

One reason why small fuel is not so economical, or rather so efficient a steam producer as larger stuff, is that the fire bed must be thinner, and it is very much more liable to burn into holes, whereby large volumes of cold air flow uncombined through the fire and direct to the chimney. All such easy inlets for air check the entrance through the fuel itself, the air taking the line of least resistance. It follows, therefore, that for a thin fire to be successful, it must be constantly kept level, and this I have never found could be done by hand. With mechanical stokers of that variety which scatter their fuel over the whole surface of the fire, when they are in good working order, and which are usually known as sprinkling stokers, this desirable end is fairly well attained. The shower of fuel is continuous, and the pieces tend to the lowest parts of the fire by preference. If we were to spread the furnace bars with lumps of coal of several pounds' weight and more or less globular in general form, there would be immense air gaps between the various pieces. If we obtain fuel only so large as an egg, we can make a thick fire which will allow several layers of such size fuel, and the air which escaped past the first layer would be gradually broken up as it passed higher layers, until it emerged on the fire surface completely consumed. In English locomotive practice large coal is used, and it is carried in a thick fire on the bars and provided with a powerful induced draft. This is an example of the rational adaptation of the size of fuel, the draft power and the fire thickness. The efficiency is good. The draft is so strong that if there were not a heavy bed of fuel the draft would break up the fire—lift it off the grate, in fact. With small nut fuel and the same fire thickness, the draft would not draw the air through the fire so well. With actual dust fuel a draft cannot be powerful, because it would blow the fuel off the grate in holes. Dust fuel in itself is not by any means poor stuff, but it cannot be burned at a high rate per square foot. If therefore, there is a question of using dust fuel because of its cheapness, we must be prepared to provide a very much larger grate area to burn a sufficient amount to raise steam. New dust, as compared with weathered dust, is nearly equal to the fuel it is made from. Its inefficiency is only a name for slow combustion, but, given grate area and care, steam raising can be effected with great economy, as is always possible with slow combustion. Slow combustion is economical, because it avoids the excess of air that seems unavoidable when quick combustion accompanies thin fires. Special tests on draft and fire thickness have shown that where there has been a partly opened damper and thin fires, the full opening of the damper, combined with considerably shorter grates and thicker fires, has reduced the total air combustion from 25 pounds per pound of fuel to about 14 pounds. Quick combustion means sharp draft, and this is what causes excess of air to be used, and the reason for slow combustion being economical is that air excess is avoided, otherwise economy ought to associate

with brisk combustion because of the high temperature. But it is useless getting a high temperature at the fuel itself if there is so much air introduced as a temperature diluent. A thin fire burning like a smithy forge looks well; it conveys the idea of perfect combustion, but it is by no means an economical fire, and for no other reason than that there is so much air to heat that there is less heat to spare for heating water.

Putting other considerations aside, there is more skill required to fire thinly than to fire highly, because of the rapid disappearance of the fuel from those spots at which the fire is thinnest. In making choice of fuel we have thus to take into consideration many factors, and as the smallest fuel is usually the cheapest, for fuel is not sold as a rule by its calorific value, the economical plan is to buy the smallest stuff our boilers enable or allow us to use. Absolute dust cannot be economically burned at a greater rate than 12 pounds per square foot of grate per hour. This rate I have found to produce good results with fuel so small that it was necessary to damp it, so as to adhere together on the shovel. It was simply dust. With ordinary coal the rate would have been 20 pounds per square foot or even more, thus showing that for the dust fuel, which could be bought very cheaply, twice the number of boilers was required.

Clearly, then, by doubling the expenditure on boilers the cheaper fuel would be available. A boiler costing in place $2,000 will burn about a thousand tons of fuel per year. Let us suppose this fuel costs $3 per ton, or a total of $3,000 per annum. By using a coal at $1.50 we might save $1,500 annually. But we should require an extra boiler at $2,000, and the interest on first cost would be, at 5 per cent., $100. Depreciatory at 10 per cent., would be $200, or a total of $300 per annum on this liberal allowance. Repairs would be less, so that if out of the city, and rent need not be considered, it would apparently pay to purchase and fire an extra boiler, if we could even save 30 cents per ton by using cheaper fuel. As a rule few fuels are so much slower of combustion than the ordinary run of stuff as to burn at only half speeds. Hence at any place with several boilers it would not imply a doubling of the boiler plant. With dust fuel carefully stoked and slowly burned great efficiency may be attained, and it is all a question of balancing the three factors of draft, full size and fire thickness. Few if any firemen keep up to their best continuously. They allow back corners to become bare and are careless of these points, but for a short time, when spurred to something special, I have always noted how careful they are to cover every square inch with fuel and fill up hollow places.

In burning coke a fire must be thick or satisfactory results cannot be secured. Coke must be broken small to suit it to the furnace, and not burned just as received from the gas works. About egg or walnut size will do. In burning hard coal on an open grate considerable depth of fuel seems to be necessary, as I should expect, but I must confess to surprise that in boiler furnaces it is burned in a very thin fire. I have been informed this is necessary, and have seen it so burned, a level, thin and even fire being maintained and fired frequently in small quantities. It is the same with hard coal locomotives; they have shallow fireboxes, which contradicts all my experience with soft coal or coke, and I should be glad of an explanation of this. When forced or assisted draft is used, it becomes necessary to proportion the fire to the intensity of the blast. As a fact, many so-called forced drafts are merely of ordinary intensity, and simply safeguards against bad atmospheric conditions. There are some fuels, coke breeze, for example, which seem to require a fan blast to burn them, and yet which must have a thin fire. In using this fuel it is very apt to burn in holes all over the fire surface, and at these holes the draft comes through and the rest of the fire becomes dull. There is a good deal of attention needed to keep these fires in order, and at the best the evaporative results are not great, but the fuel is so very cheap as compared with ordinary fuel that it may pay to use it in spite of its very severe clinkering.

In English practice, which favors boilers of the internal furnace type, there is not much room for choice of fuels and thick fires. These are only possible in locomotive type fireboxes or with externally fired boilers. In these latter there is ample room, for the water can be kept down, and fuel kept to any necessary thickness. It always seems to me to be correct practice to so arrange matters that the gas which issues at the top of a fire shall be combustible carbonic oxide, and that fresh air to correct amount shall be admitted above the fire to complete its combustion. But this cannot be done effectually in furnaces which are too much surrounded by water-cooled plates, for these prevent perfect combustion, especially where very bituminous fuels are used. It is necessary that furnaces be protected from cooling, for the gases from bituminous coals must not be cooled, or they will not burn. They will at most partially burn with formation of soot.

In a recent German arrangement I recently had an opportunity of inspecting, the fuel, bituminous, was simply ground to flour and sifted into an air tube, by which it was blown into a grateless furnace lined with firebrick. So ground fine and, of course, intimately mixed with the carrying stream of air, coal burns like a large gas jet and very perfectly. This is in a sense an ideal system of combustion, and only requires some means of dealing with the fine dust, which must be carried forward into the flues or out of the chimney. But it is ideal in that every particle of coal is surrounded by oxygen, and able to get hold of it very much better than when in large quantities, the ratio of area to bulk being, of course, very much larger in small particles.

The combustion of dust in a current of air as compared with the burning of fuel on a grate may be considered as paralleling a Bunsen flame of mine gas and air, and a flame of gas touching air on its outside surface only. In one case combustion is perfect; in the other it may be so, but runs great risk of not being so. Small fuel is theoretically best, but when massed together on a grate the air supply cannot get to it. A grate-supported fire must thus have fuel of some size or combustion must be very slow. It is then that the principle needs to be changed and the grate abolished in favor of air-borne fuel. Atomized coal is like atomized oil, and these atomized fuels approximate to gas in their behavior. Like gas, the proportion of air can be regulated, and economy and efficiency secured.

* * *

NOTE ON FIBER GEARS.

The writer has had an experience with fiber gears which may prove of interest to others. The gears, enclosed in a cast iron casing, were used to transmit power from a 5-HP. motor to a submerged centrifugal pump. The pinion, 25 T., 5 p., 5" p. d., 1¾" face, of fiber, was fitted to the motor shaft which ran 1,000 revolutions per minute. The gear 36 T., 5 p., 7.2" p. d., 1¾" face, of cast iron, was secured to the pump shaft and ran 694 revolutions per minute. The gears were bevel. The pinion was formed of two disks of fiber driven upon a cast iron flanged center and riveted to the same by brass wire rivets. Both pinion and gear had cut teeth. They were fitted with the usual amount of clearance, but after being in position for two or three weeks, complaint was made that some of the teeth had broken. Investigation showed that the fiber had swollen to such an extent as to project about 1-32 inch beyond the rivets, which were originally flush. This meant that the diameter of the gear had become enlarged. The teeth that had stripped were compressed, showing the effect of excessive meshing. The remedy consisted in giving the gears considerable play when first placed in position.

The length of fiber along the rivets was about 2 inches, and the projection when swollen about 1-32 inch, or 1-64 inch to the inch. The atmosphere of the room in which these gears were placed was so damp that the walls were continually dripping. The Laminar Fiber Co., of Cambridge, Mass., after the trouble had occurred, was asked some questions concerning fiber. They stated that but little information existed as to the tensile strength of fiber. One of their customers had a few pieces tested and found the tensile strength to run from 7,500 to 9,000 pounds per square inch. These tests were made at the Massachusetts Institute of Technology, Boston, and the Worcester Polytechnic Institute. The test pieces, taken from samples, bought of them in course of trade, were ⅝ inch square and about 7 inches long. The break occurred where the sample was clamped in the machine. The material is affected by moisture, the average swelling from being placed in a damp room is about 1-64 inch per inch. The gears may be run in oil without injury if due allowance for the swelling be made. The color of the fiber has no effect upon its strength, the red, gray and black being equally strong.

The writer hopes that others may give their experience with fiber gears. WM. SANGSTER.

WHAT MECHANICS THINK.

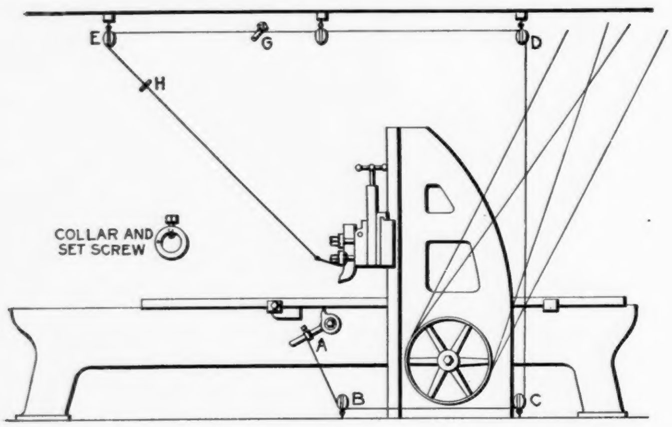
A DEPARTMENT FOR THE EXPRESSION OF PRACTICAL IDEAS OF INTEREST, TECHNICAL OR OTHERWISE.

Write on one side of the paper only, and when sketches are necessary, send them. No matter how rough the sketches may be, we will see that they are properly reproduced.

PLANER TOOL LIFTING DEVICE.

The following is a description of a device which may be helpful to someone who is obliged to run a large planer not fitted with an arrangement for lifting the tool on the return stroke. Having a quantity of large steel castings to machine on a large Pond planer, I was troubled quite a little by chips rolling under the tool on the back stroke, causing it to lift up and fall back, often injuring it for further service until ground.

This is the way I rigged up to prevent the trouble. I first made a collar with a set screw to go on the rocker lever at A and then obtained four small pulleys about $1\frac{1}{2}$ inches in diameter and placed one on the floor at B, another at C in such a place as would allow a cord to clear the planer and reach the ceiling. Directly over C I placed another pulley D, another directly over the center of the planer at E, and some five or six feet ahead of the cross bar. Then I ran a strong cord from the collar A on the rocker (taking a few turns around the rocker for adjustment, when the tool was at different heights) up over the various pulleys, and finally to the tool block as shown in the sketch. The cord was fastened to the tool block by means of a hook made to pass under the lower strap and bent up over the bolt. To attach the cord, therefore, all that



was necessary was to lift the tool block slightly and hook on the cord. The height to which the tool was raised was adjusted by changing the position of the collar on the rocker arm and the cord was kept tight by turning the collar so as to wind extra cord on the lever.

I have used this device with success when planing out T-slots, similar to the slots in planer platens.

A small weight placed at G and a piece knotted at H, to prevent the cord from passing through E, serve to swing the cord and hook out of the way when not in use. The fastening of the hook and the adjustment of the length of the cord can be made while the planer is running on the cutting stroke.

C. G.

THAT INDICATOR CARD - A LATHE VISE.

Unless I have missed my paper, I have seen no comments on that freak card.* What are my views in regard to it? Well, I know but very little about indicator cards; but, from what I know of the engine, these are my conclusions: The admission line is made by compression; and when the engine passes the center and starts on the return stroke, the steam pressure is so weak, that it will not resist the downward pressure of the spring. The pencil describes an expansion line in place of a steam line, and it commences right at the beginning of the stroke. You will remember the stroke is 48 inches; engine cutting off at 21 inches. Now it might be possible that an indicator with a very weak spring would show a different card. What do mechanics think of my theory?

Did you ever notice that the two worst things in most machine shops are the grind stone belt and the vise that the lathe men have to use? And where there is only one vise for half a dozen lathers, someone must wait until the other fellow gets done centering a pile of bolts, or what not. The thing then becomes a vice.

The enclosed sketch is my idea of what is wanted in all well regulated fam—machine shops. It is simply a vise attached to the lathe, by a bracket, A, Fig. 1, as shown. Shape the

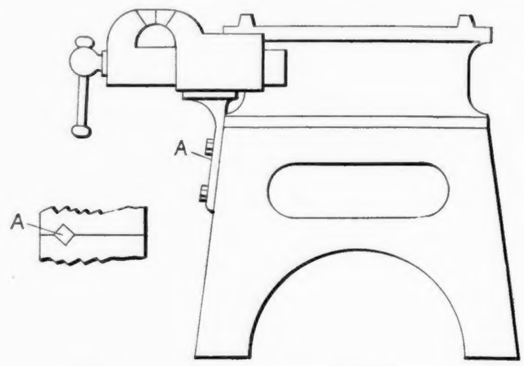


FIG. 2. FIG. 1.

bracket to suit the design of the lathe. The vise should have offset jaws, and need not open more than three inches. If the jaws had a V, A, as shown in Fig. 2, it would be of great advantage. Furthermore, if the vise swiveled on the bracket, it would help out. Oh, the weary steps it would save a man in the course of a year to have a vise attached to his lathe, and how handy! No, it is not in the way, and when doing piece work, well! "And the half has never been told."

Vallejo, Cal. W. De Sanno.

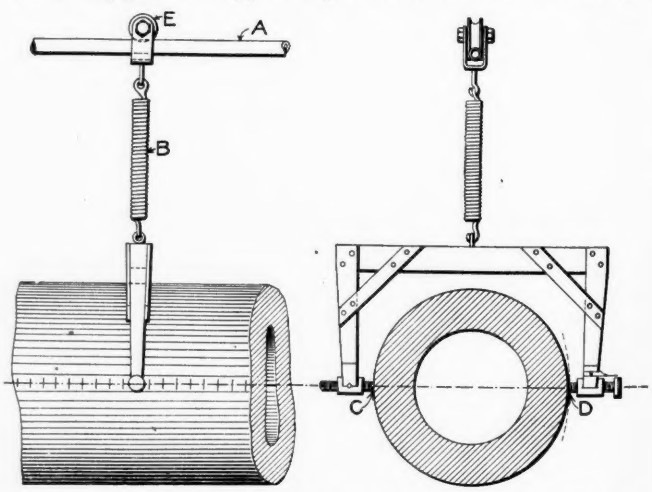
* August issue, page 389.

A METHOD OF USING WOODEN BACK CALIPERS.

With reference to the article on wooden back calipers in the October number a suggestion of a convenient method of using these calipers may be in order.

The sketch shows how the calipers are arranged where a number of measurements are to be taken on the same piece, as in calipering the surface of a large gun tube, where measurements are taken at intervals of one inch along the entire length.

An iron pipe A is supported parallel to the axis of the tube



at such a height as to allow the caliper to swing with its measuring points in the plane of the horizontal axis of the piece.

B is a spiral spring connecting the caliper with the trolley wheel E.

In use the point C is held against the object being calipered, while the point D is swung through an arc of a circle whose center is at C.

This insures the measurement of the longest diameter, which is found when the contact points are diametrically opposite.

As the entire weight of the caliper is sustained by the spring, but very slight force is needed to move the point D through its measuring arc. This enables the operator to obtain a very much more delicate "touch" than is obtained with the ordinary methods of calipering.

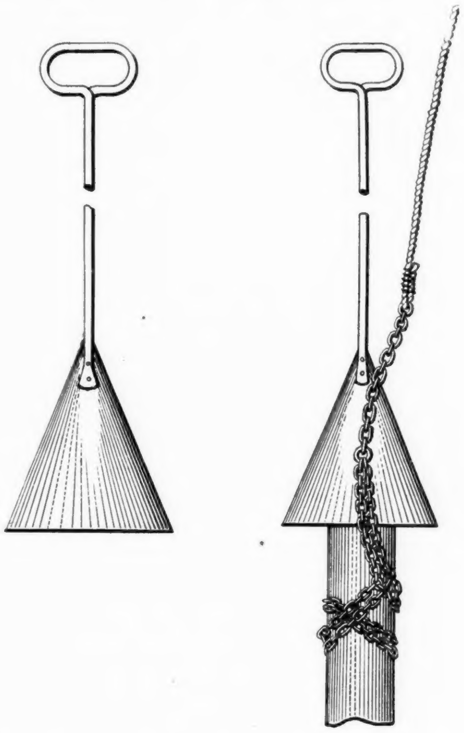
The measurement at one point having been taken, the trolley provides a convenient means of moving the apparatus to the successive points to be measured. GEORGE HENRY.

Providence, R. I.

RECLAIMING A DEEP WELL PISTON ROD.

If any of my fellow readers are unfortunate enough to have the piston rod of a deep well lifting pump break, here is a simple device for recovering the lower portion:

In the sketch, to the left is shown an inverted funnel-shaped piece of sheet iron, with a wrought iron rod riveted to its apex. This is lowered to the level of the break, when, by slightly raising and lowering, or, if you will pardon the expression, fishing,



it is readily seated over the broken end of the piston rod. A double noosed chain lashed to the end of a line is then slipped over the wrought iron rod; on hauling up the line the chain takes a firm hold on the piston rod, which is then quickly brought to the surface, where repairs can be easily made. The chain slipped over the funnel is shown in the sketch to the right.

Hokendauqua, Pa. GEO. H. WALTMAN.

THREE KINKS.

In a previous issue of MACHINERY a threaded dog was shown for driving studs or bolts by the screw end. A cheap and excellent substitute for this is to make a round nut by turning the corners off from a hexagon nut on a nut arbor, and sawing the nut apart, making two half nuts. This is used with an ordinary lathe dog, and has the advantage of being easily and quickly put on or removed. It is a complete protection to the thread, and will drive a heavier cut than a smaller dog on the smooth end before threading.

Putting soap suds on a piston to detect air leaks, as related in a recent issue, is a good idea, but another plan often used for such purposes is to submerge the object in clear, hot water; the heat of the water makes the object hot and heats the air confined within, expanding it, and if there are any leaks air bubbles will appear in a procession from each leak, so it is no trouble to locate every leak. Of course, it must be taken out of the water before it cools or water will enter the leaks as soon as the air contracts below atmospheric pressure.

Tool steel, even when well annealed, is difficult to drill with a twist drill, as it rapidly wears away the outer corners of the drill and destroys the clearance, so that it gets hot and sticks fast. A partial remedy for this is to grind one lip of the drill longer than the other, so it will drill a hole larger than its nominal size, and thus get clearance, but even at best the drill wears very fast and must be kept sharp.

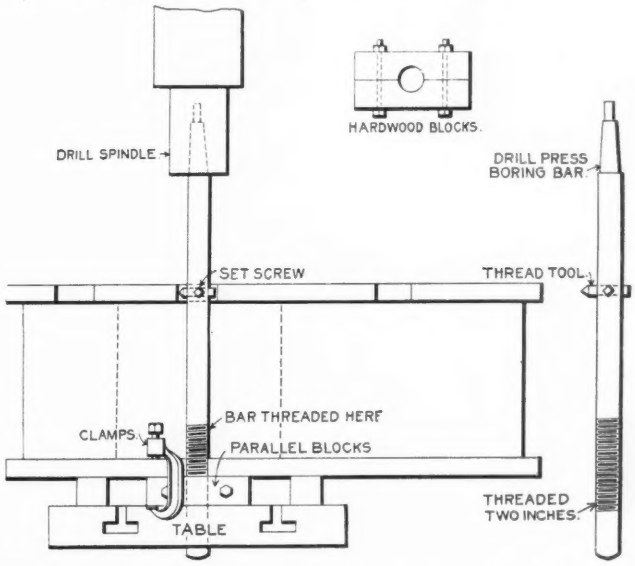
The old school machinist will make a flat drill that will beat any twist drill for such work, but they soon wear below size and have to be re-dressed and, further, the effort and time required to make such a drill is not available in all shops.

T. R. Almond, in an early issue, showed that a hog nose drill, if started in the work through a bush a little larger than the drill, would make a hole the size of the bush, and I found this principle was good for drilling tool steel. A hog nose drill does not cut, it only scrapes or shoves the metal off, and it is desirable to make use of the cutting rake of the twist drill, so I start the hole with a drill with one lip ground long to make the hole larger, then drill through with a small drill a little larger than the thickness of the large drill point. Take another drill the same size as the large starting drill, and grind it square on the end instead of the usual pointed shape, just as if you were going to make a square bottom counter sink, but making one lip do all the cutting. This will drill a hole the full size it is started and preserve the clearance. When the corners wears off one lip grind it back and let the other cut until dull. If the steel is hard the drill must be made harder, but this need be done only for a short distance on the end. This looks like a lot of work for a seemingly small object, but it will all be appreciated after one has failed with the regularly ground twist drill.

BELL CRANK.

THREADING STUFFING BOXES.

While building a small triple-expansion engine it became necessary to cut the threads for the stuffing boxes. The bottom heads were cast on the cylinders and the cylinder diameters were so large that there was no lathe in the shop that would swing the job. So I took the bar that had been used to bore the cylinders on the drill press, and threaded it for about 2 inches, as shown in the sketch, 12 threads per inch, which were the number of threads that were to be cut in the stuffing boxes. Then, letting the bar run in a bushing in a drill press table, I clamped two hard wood pieces on the threaded portion of the bar and chased



threads in the blocks by running the bar back and forward. I then fastened the blocks to the top of the cylinders by clamps, turned the cylinders over on the drill press table and was ready for business. The threads that had been chased in the blocks served to lead the bar and the cutter inserted at its upper end. I found an old belt that I put on for a back up belt and finished the job in four and one-half hours, including the time spent in getting ready. C. W. GLEASON.

New York.

A FIRE LIGHTER FOR BLACKSMITHS.

We have had considerable trouble with lighting our forge fire. It was customary to pick up a piece of oily waste to start a fire with, wood shavings not always being at hand, and you can imagine the result on lighting the waste. It would not only make a heavy smoke, but an unpleasant odor that floated into the atmosphere of the shop and reminded one of the days

of smoking out woodchucks. Thinking the nuisance might be somewhat abated, we looked over an accumulation of pipe fittings and selected a piece of ⅜-inch pipe, about 1 foot long and found a cap to screw on one end. Near the cap end we drilled five or six small holes, and then attached the pipe to the gas jet with a rubber hose, and our fire lighter was ready for use. To use this cheap and useful fire starter, light it at the holes and place it in the forge over the tuyere, cover lightly with your coal and put on the blast. In a short time you have an excellent fire and not any smoke. If any readers are troubled as we were, actual use of the device will convince them of its utility. WILHELM.

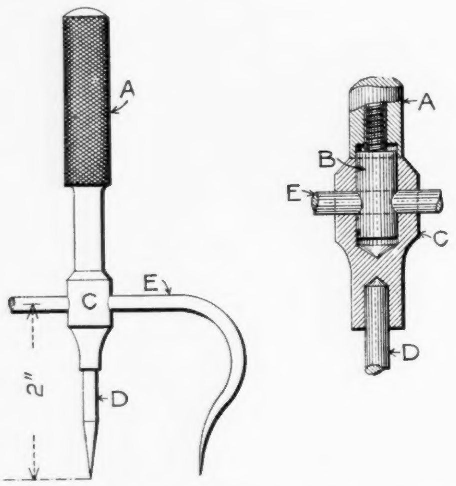
A MISTAKE.

Mr. A. E. Phillips, Rockford, Ill., kindly calls attention to an error in the second example under the first rule submitted by G. L. R. in the last issue. The problem was to cut a screw of ⅝-inch pitch, and the calculation should have been made by taking the number of threads to be cut *per inch*, instead of the measurement from one thread to another. Thus, instead of multiplying ⅝ by 60, $1\frac{3}{5}$, the number of threads per inch, should have been used. $1\frac{3}{5} = 8\text{-}5$, so if 8-5 had been multiplied by some number that would give an even result—say, 80—and the calculation carried through on this basis, the result would have been right.

A HANDY DIVIDER.

This is a simple form of divider that is easily made, is serviceable and is very rigid.

A is the handle, made out of ½-inch round steel 3 inches long, with 2 inches of knurling and with the lower part turned off and tapped for a 3-16-inch screw. This screw appears at the sectional view at the right, the handle being lettered A as in the other view.



C is a piece ⅝ inch in diameter, ½ inch between shoulders and with a taper part ½ inch long. The point D is of 3-16-inch steel, 1⅝ inches long, and forced into C ⅜ of an inch. If preferred C can be tapped out to receive D, so as to have changeable points, or C and D can be made of one piece, out of cast steel.

The adjustable needle is of 3-16-inch steel made of any desired length to suit the user. The method of adjustment and of clamping rigidly in place will be understood from the sectional view. C is drilled to receive the needle wire E, and also the piece B, which acts as a binding piece, or gib, the wire passing through both C and B. The upper end of B is threaded to enter the handle A, and by turning the handle it will bind against piece C and draw up piece B, thus clamping all parts of the instrument solidly. It is convenient to have two heads to use on a straight wire as a pair of trams. C. A. M.

A HINT TO ELECTRICAL EXPERIMENTERS.

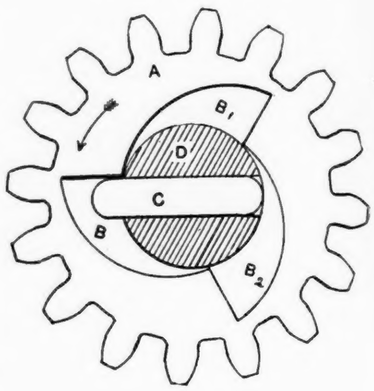
As many readers—especially the younger class—of "Machinery" are interested in building electric bells, induction coils, etc., and as the price of platinum is so high, I thought the following points would be read with interest. In nearly every town, and even in the smaller villages, there is the local dentist. By getting on the right side of him you will be able to procure some of his surplus "store teeth" that he cannot use. In each tooth there are pure platinum pins.

These pins can be utilized for making the contact points in bells, coils, etc. These pins are about one-eighth inch long and a trifle over one-thirty-second inch in diameter. By flattening them, they can be soldered to the contact breakers, or by drilling same and fixing the pin in the hole a smart stroke of a small hammer will rivet them securely and make as efficient contact points as if you had paid a considerable sum for new platinum. F. H. JACKSON.

Angelica, N. Y.

A SUBSTITUTE FOR A PAWL AND RATCHET.

Upon examining a lawn mower which was observed to make none of the familiar rasping, clicking sounds when backing up, the little device shown in the sketch was found substituted for the more familiar pawl and ratchet attachment. While it may be old it was new to the writer, and will probably be new to many others, and it would seem that its field of usefulness could be profitably extended. Perchance, however, it is well plastered by patent right.



The pinion A, when rotating to the left in the direction of the arrow, will drive the shaft D through the medium of the little pin C. This pin is a loose fit in a hole drilled through the shaft. Now, when the motion of the pinion is reversed the pin C is pushed through the shaft by the curved side of the cavity B, and is moved out into cavity B. This action is repeated indefinitely through each of the cavities, the pin crossing and recrossing the shaft until the motion is again reversed, when the abutment of whatever cavity the end of the pin stops in catches it and again drives the shaft.

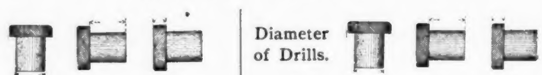
It might seem that there would be a failing position, but such is not the case in practice, and as it is simple and free from springs, the device seems worthy of notice.

Corning, N. Y. FRED E. ROGERS.

STANDARD BUSHINGS.

The accompanying table of sizes for standard interchangeable jig bushings is sent you in compliance with your request in an editorial in the November issue, and represents the writer's practice as regards the systemization of jig making. The table was made a number of years ago, and has proven very satisfactory, many sets of bushings having been made therefrom.

STANDARD BUSHINGS.



Diameter of Drills.				Diameter of Drills.			
1/16	7/16	1/2	1/4	1 3/16	1 7/8	1 1/2	1/2
1/8	..	..	..	1 1/4	..	..	..
3/16	..	..	..	1 5/16	..	..	..
1/4	3/4	3/4	5/16	1 3/8	..	..	..
5/16	..	..	..	1 7/16	..	..	..
3/8	..	..	..	1 1/2	..	..	..
7/16	..	..	..	1 9/16	2 1/4	1 3/4	9/16
1/2	1 1/8	1	3/8	1 5/8	..	..	..
9/16	..	..	..	1 11/16	..	..	..
5/8	..	..	..	1 3/4	..	..	..
11/16	..	..	..	1 13/16	..	..	..
3/4	..	..	..	1 7/8	..	..	..
13/16	1 1/2	1 1/4	7/16	1 15/16	2 3/4	2	5/8
7/8	..	..	..	2	..	..	..
15/16	..	..	..	2 1/16	..	..	..
1	..	..	..	2 1/8	..	..	..
1 1/16	..	..	..	2 3/16	..	..	..
1 1/8	..	..	..	2 1/4	..	..	..

It will be noticed that the outside diameter of each group of bushings corresponds with the inside diameter, or drill hole, of the last bushing in the succeeding group. This is done in order that the bushings will "nest" one with another. In other words, so that any standard jig hole can be bushed to take any size drill. Suppose, for instance, that we wished to bush a 2¾-inch jig hole to take a 1 7-16 inch drill. The 1 7-16 inch bushing fits the 1⅞-inch bushing, and this, in turn, fits the jig hole. Thus, it is obvious that any size drill may be used with any jig whose holes are made in accordance with this system.

Cincinnati, Ohio. H. M. NORRIS.

PRACTICAL PROBLEMS.—2.

TWO NEW PROBLEMS WITH ANSWERS TO THOSE IN THE LAST ISSUE.

(Solutions must be received by the 10th of the month to insure publication in the next issue.)

Problem 3.—A Piston Rod Starter.

The useful tool shown in Fig. 1 was made at the Fall Brook Railway shops for removing piston rods from the taper fits in the crosshead.

Anyone who has tried to start one of these taper fits after

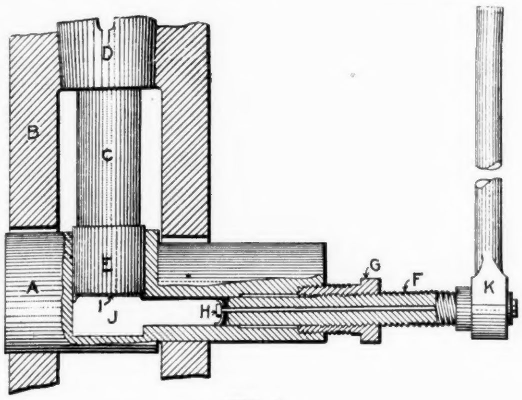


FIG. 1.

it had been in place for a year or so, by wedging or similar process, knows what a trial it sometimes is to break the two apart and a broken crosshead has sometimes been the result of not getting the blocking directly on the end of the piston rod.

The part of the device shown at A is about the shape of the regular removable crosshead pin, but is small enough to go in the smallest holes.

It is shown in place in the crosshead B with the piston E in line with the piston rod D. The piece C is to fill the space between the two.

The piston E is provided with cup leather packing I, and the space J is filled with tallow or some similar substance that will not ooze out when not in use.

The screw F works in the nut G and has a square on the outer end for the handle K. The inner end of this screw has a cup leather packing, and to prevent its being too rapidly worn out by the rotation, it is attached to a small disc, which is swiveled on the end of the screw by the little through bolt H, as shown.

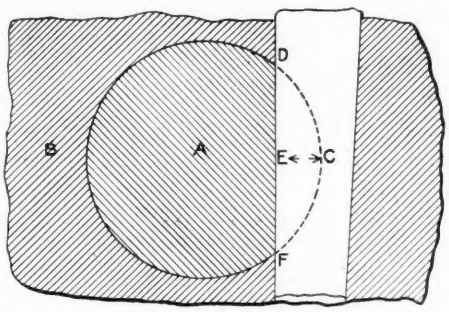


FIG. 2.

It will be seen from this description that we have an excellent example of the lever, screw and hydraulic press, and a very obstinate fit is broken by the use of it with astonishing ease. It will perhaps be interesting to calculate the pressure transmitted to the end of the piston rod.

The piston E is two inches in diameter, the screw F is one inch in diameter, and has eight threads to the inch, the end of the screw forming the piston is four-fifths of an inch in diameter, the length of the handle K is sixteen inches, and the force applied to the extreme end will be called fifty pounds, the efficiency of the device can be rated at 25 per cent.

4.—A Principle of Geometry.

A shaft is to be secured in the hub of a wheel by a key of 5 degree taper. The key is to be set at right angles to the axis of the shaft, after the manner of the ordinary crank fastening of the bicycle, as shown in the sketch, Fig. 2.

The diameter of the shaft is five inches, and it is desired that the flattened side of the shaft D F shall be just four times the depth of the cut C E.

What is the depth of C E and the length of D. F?

Some may think that this is a problem in trigonometry, but it is not necessarily so.

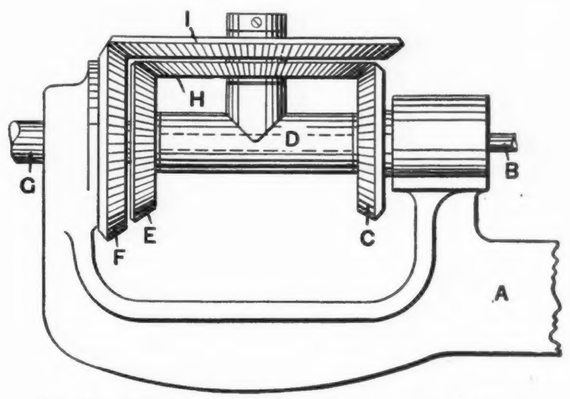
A principle of geometry is involved, which if well understood, will often save reference to a table of sines and tangents.

ANSWERS TO PROBLEMS 1 AND 2.

The following correct solutions to problems 1 and 2 in MACHINERY for November have been received in time for publication:

Mr. F. A. Eckert, of Chicago, Ill., says that the gear problem can be easily solved if we begin at the middle and work both ways. Begin by giving gears I and H with sleeve D one whole revolution about the shaft B. Since there are 40 teeth on F and 60 on I gear, I will make 40 ÷ 60, or 2-3 of a rotation about axis of I, and as H and I revolve as one gear, H also makes two-thirds of a rotation. Now, assume that gear I is disengaged from dead gear F, but that H E and C remain, as shown in the sketch.

If, now, we rotate sleeve D once about shaft B, gears I and H will receive no rotation about their axis, but gears E and C will both rotate once in the same direction. Now, rotate I with H two-thirds of a turn in the direction it would have moved had I rolled on F in the first motion. In the second motion E will rotate in the opposite direction to that of the first, and C will rotate in the same direction. The results are the same whether the two motions act together or alternately.



Reprinted from last issue to illustrate Problem 1.

Now, to find the resultant motion of E and C and their ratios we will assume motion in one direction as + and in the other as —.

$$\text{I.}\begin{cases}\text{Rotations of E} = 1 - \dfrac{\frac{2}{3} \times 50}{32} = 1 - \dfrac{25}{24} = -\dfrac{1}{24} \\[2ex] \text{Rotations of C} = 1 + \dfrac{\frac{2}{3} \times 50}{31} = 1 + \dfrac{100}{93} = +\dfrac{193}{93}\end{cases}$$

Whence the ratio of the driver to the driven gears =

$$\frac{\frac{1}{24}}{\frac{193}{93}} = \frac{1 \times 93}{24 \times 193} = \frac{31}{1544} = .0200 +$$

From I we can see that the positive and negative signs denote opposite directions of motion.

The question of pressure in problem 2 can be solved by algebra as follows:

Let pressure in D = x lb. per sq. in.

Then pressure in E = 8-11 x lb. per sq. in.

Area of 4-inch piston = 12.566 sq. in.

Area of 5-inch piston = 19.635 sq. in.

Then from $12.566\,x + 40\,(19.635) = 40\,(12.566) + \dfrac{8\,x}{11}\,(19.635$
$+ 141.372.$

$x\,(14.28 - 12.566) = 141.372 - 40\,(19.635 - 12.566).$

$1.714\,x = 141.089.$

$x = 82.316$ lb. per sq. in.

$\dfrac{8\,x}{11} = 59.875$ lb. per sq. in.

If Mr. Eckert had carried his areas out to four places of decimals his results would have been exact, 82.5 and 60 pound, respectively, which was the reason for making the resultant pressure 141.372 lb. per sq. in.

The following solution of No. 1 was sent by Mr. Gus Tzaut, of Schenectady, N. Y.:

To find the ratio of the driver C to the driven E, proceed as follows: We may first consider all the wheels locked together and the whole combination turning on the axis G, B. Give that combination one turn in a right-hand direction and call it +. In this condition the F, E, and C are each making one rotation around their axis, while I and H do not turn.

Then wheels locked, we have,

C, H, I, E, F.
+1, 0, 0, + 1, + 1.

But according to the conditions of the problem F is fixed so the frame A cannot turn, so we must bring A back to its original position, and to that end we unlock the wheels and give F one turn in a left-hand direction, which we will call negative (—).

But while F makes one rotation I makes 40-60 or 2-3 of a rotation and H also makes 2-3 of a rotation in a + direction. Now, H is driving C and E, gear C in + direction and E in a — direction. Hence C will make $\frac{50}{31} \times \frac{2}{3}$ or $+ 1\frac{7}{93}$ rotations, and E will make $\frac{50}{32} \times \frac{2}{3}$ or $- 1\frac{1}{24}$ rotations.

We now have with wheels unlocked

C	H	I	E	F
$+1\frac{7}{93}$	$+\frac{2}{3}$	$+\frac{2}{3}$	$-1\frac{1}{24}$	-1

Taking the algebraic sum of the two resultants we have

C	H	I	E	F	
$+1$	0	0	$+1$	$+1$	(wheels locked).
$+1\frac{7}{93}$	$+\frac{2}{3}$	$+\frac{2}{3}$	$-1\frac{1}{24}$	-1	(wheels unlocked).
$+2\frac{7}{93}$	$+\frac{2}{3}$	$+\frac{2}{3}$	$-1\frac{1}{24}$	0	

which gives the total motion of each part.

We find that when C is making + 2 7-93 rotations E is making — 1-24 of a rotation. Reducing the ratio to 1, we have

$$\frac{\frac{1}{24}}{2\frac{7}{93}} = \frac{1 \times 93}{24 \times 193} = \frac{31}{1544}$$

Hence the ratio of C to E is 1 to $\frac{31}{1544}$ or approximately 1 : .0200+ and the direction of rotation of shafts B and G is opposed.

Mr. Elmer G. Eberhardt, of Newark, N. J., sends the following clear and concise solution to No. 2:

I think there was a misprint in the figures 141,372, so I took it to be 141.372, which gives values as follows: Referring to the figure on page 94, as A and B are unequal in size, the difference in area is 19.64 sq. in.; area of B, — 12.57 sq.in.; area of A, = 7.07 sq. in. Now, by the conditions of the problem, when a pressure of 40 lbs. is in C the piece G exerts a pressure of 141.372 lbs. to the right, but to do this it must overcome a pressure exerted on G to the left; therefore the force from pressure in C is equal to the sum of the force on G to the left, plus the force 141.372 lb. to the right. Calling the force on G from C (a) and the force to the left (b) we have the following equation showing the relation of the forces:

$$a = b + 141.372 \ldots\ldots (1)$$

but (a) is the product of the effective area × 40 lbs., or 40 × 7.07 = 282.8 lbs., and (b) is the difference between the forces on A and B, which is as follows:

The pressure in D is unknown, but is denoted by x and that in E by 8x/11.

The force on A is 12.57x lb. and on B is 19.64 × 8x-11 = 14.28x lbs. so the difference in forces, or b, = 1.71x.

Now, putting these values in equation (1) we have

$282.8 = 1.71x + 141.372$ lbs.

$1.71x = 141.428$ lbs.

$x = 82.1$ lb. pressure in D.

$\frac{8x}{11} = 59.5$ lbs. pressure in E.

These values being based on the supposition that 141.372 is the force to the right.

The following excellent method of finding the ratios of the driver and driven gears in problem 1 was sent by Mr. Frank H. Jeannin, of Pine Bluff, Ark:

Suppose that all the wheels are locked and that the whole mechanism is turned in a left-hand or — direction one turn around the axis G B. But the frame A and gear F are to remain stationary. Therefore to get this righted we turn after unlocking the wheels A one turn in a right-hand or + direction with the sleeve D fixed. The turns of C will be $-(\frac{50}{31} \times \frac{40}{60})$ and of H and I $\frac{40}{60}$ and of E $+(\frac{50}{32} \times \frac{40}{60})$ and of F and A + 1 and of D zero.

Tabulating we have

	C	H and I	E	F and A	D
Wheels locked	-1	0	-1	-1	-1
Arm D fixed	$-(\frac{50}{31} \times \frac{40}{60})$	$\frac{40}{60}$	$+(\frac{50}{32} \times \frac{40}{60})$	$+1$	0
	$-2\frac{7}{93}$	$\frac{2}{3}$	$\frac{1}{24}$	0	-1

Hence C turns 2 7-93 times in a left-hand direction, and F 1-24 turn in a right-hand direction. Now, to get the ratio of the driver to the driven, when F stands still divide 2 7-93 by 1-24 = 49 25-31 or ratio of driver to driven = 49 25-31 : 1.

A number of replies were received which, through a misapprehension of the conditions, were incorrect, but all were creditable efforts, even though the correct result was not obtained.

The substitution of a comma for the decimal point in the question of pressure was a stumbling block to some; 141,372 lbs. should have been 141.372 lbs.

The writer has arranged the elements of the gear problem in the following formula, which may be of interest:

$$R = \frac{\frac{F\,H}{C\,I} + 1}{\frac{F\,H}{E\,I} \sim 1} = \frac{\frac{40 \times 50}{31 \times 60} + 1}{\frac{40 \times 50}{32 \times 60} \sim 1} = 49\tfrac{25}{31} : 1$$

The sign ~ means "the difference between," and when the fraction preceding 1 is greater than 1, as in this case, the directions are opposed and when less than 1 they are in the same direction.

Some of the solutions give the ratio a 1 : .0200+, which is practically the same.

FRED E. ROGERS.

* * *

TORPEDO BOAT DESTROYERS.

At the meeting of the Society of Naval Architects and Marine Engineers, recently held in New York, Mr. Geo. W. Dickie, of the Union Iron Works, San Francisco, submitted a paper upon torpedo boat destroyers for sea service on the Pacific coast, in which he contended for a more seaworthy type of boat than has heretofore been constructed of this character. A destroyer should be able to keep the sea with a fleet, for the protection of the latter, should be equipped for scouting duty and should be able to easily make the great distance between the harbors of the Pacific Ocean, even in rough weather. While he believd that the destroyers lately contracted for by the government are a great improvement in this class of vessels, he said that they are not entirely suited to the service required. Designs for a vessel which he believed would meet the conditions were submitted, and it is intresting to compare the principal dimensions with those of the department drawings as given by Mr. Hichborn. Mr. Dickie aims to secure a more seaworthy boat of heavier construction and with heavier machinery as a safeguard against disaster or breakdown, and sacrifices a little in speed, preferring to have the boat capable of maintaining a fairly high speed during a long period of time and without repairs, rather than an enormously high speed for a short time and then at great risk. He estimated that the boat would steam from San Francisco to Honolulu at a continuous rate of 15 knots. The first column below gives the department's figures and the second column those of Mr. Dickie.

Length on load water-line	245 ft. 0 ins.	250 ft.
Beam at water-line	23 ft. 0 ins.	25 ft.
Draft	6 ft. 6 ins.	8 ft.
Corresponding displacement (in tons)	420	640
Speed per hour in knots	28	25
I. HP.	8,000	7,000

* * *

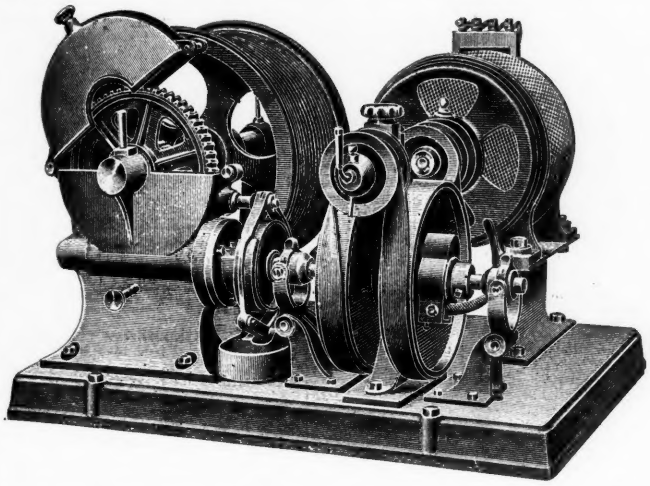
The article upon the apprentice question in the last issue, for which we neglected to give proper credit, was from a paper read before the American Foundrymen's Associatioin by P. W. Gates, of the Gates Iron Works, Chicago.

ITEMS OF MECHANICAL INTEREST.

NOTES GLEANED FROM OUR CONTEMPORARIES.

A Belt Reversing Motion.

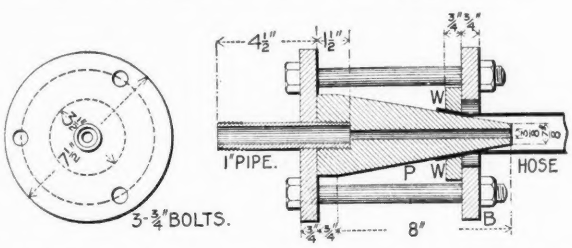
An interesting example of belt gearing is shown in the accompanying illustration, which is reproduced from the London "Engineering." It is applied by Messrs. Schelter and Giesecke, of Germany, to an electric hoisting engine, and its construction is so clear that but little explanation is needed. The motor is of



the alternating type, and revolves in one direction only. On the motor shaft is a small fixed belt pulley; another pulley opposite serves as a tightener. The two large pulleys at right angles to the former turn in opposite directions; they are loose on the wormshaft, with which either can be coupled by shifting its conical sleeve. In this way the load is raised or lowered. In order to reverse, all the resistance of the motor is cut out; motor and worm are then coupled; for slackening speed part of the resistance is thrown in, the rest when the worm is released again.

A Hose Holder.

In a recent issue of "Locomotive Engineering" is a description of a handy hose holder, contributed by Lawford H. Fry, who states that it is in use at the Baldwin Locomotive Works for holding hose while it is subjected to water pressure for experimental purposes. Hydraulic testing has to be done to a greater or less extent in many kinds of work, if it is nothing more than for the purpose of testing the soundness of castings, and it is probably the common experience of all that the fastenings by which the hose is attached are continually giving trouble. Mr. Fry's description of the Baldwin apparatus, therefore, will be of interest, even though one has no hose pipe to test.



In the figure, P is a conical cast iron plug, the taper surface being turned smooth to receive the hose. A hole ⅜ inch in diameter is drilled through the center of the plug to deliver the water to the hose. At the back end the hole is enlarged and tapped out to receive a piece of pipe to make connection with the hydraulic main. To hold the hose, it is slipped on to the plug, through the holes in the back plate B B and the washer W W. The hole in the washer is turned out to the same taper as the plug to avoid cutting the hose.

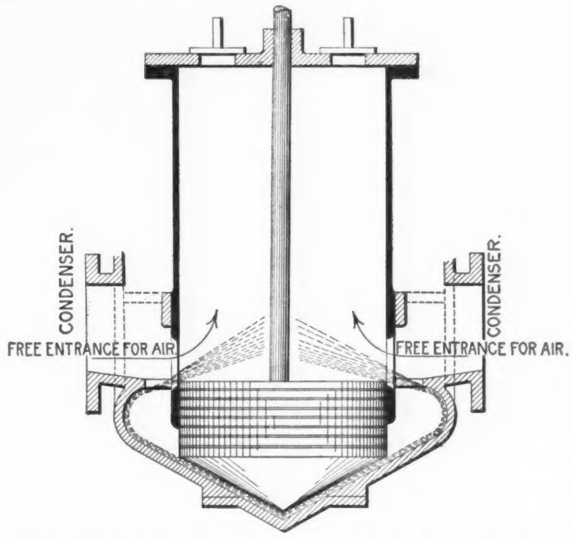
The hose being in position, the back plate is pulled up by tightening the three bolts shown. This draws the washer up the plug and wedges the hose tightly betwen washer and plug, making so snug a joint that enough water pressure can be put into the hose to burst it, without leaking occurring at the joint.

To make the device useful for hose of any diameter between ⅞ inch and 3½ inches, a set of washers of different bores is provided. With the larger washers the back plate B is discarded; the outside diameter of the washer is made 7½ inches; the bolts go through the washer and the nuts pull directly upon it.

Peculiar Air-Pump Cylinder.

"The Mechanical Engineer" has illustrated a novel form of air pump, which is designed to overcome some of the difficulties met with in the pump of ordinary type.

There is always more or less air in the condenser, part of which is carried over with the water and steam, and part is sometimes due to leakage, and this must be pumped out simultaneously with the water of condensation in order to maintain the vacuum. An examination of the drawings of a common bucket pump will show how antagonistic are these two operations. When the bucket is in its lowest position, if the water rises high enough to submerge it, no air will be drawn out during that stroke and similarly if the bucket is not covered with water in this position, the air will be drawn off with very little or no water with it. The Edwards pump, which is the one referred to, gets around the trouble and makes the pumping action for both water and air simultaneous by the arrangement shown in the accompanying sketch.



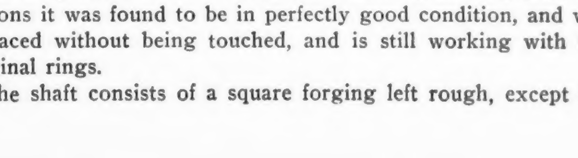
At the base of the pump is a casting which forms a reservoir into which the water from the condenser drains when the plunger is up. When the plunger returns, it dips into the water collected in the reservoir and sends it in a spray into the pump barrel above the plunger, as indicated.

On the downward stroke, also, a vacuum is created in the part of the cylinder above the plunger, and as soon as the latter passes the ports at the lower end of the barrel there is a free opening to the air, which is therefore drawn in independently of the water, as indicated by the arrows, ready to be expelled by the next upward stroke of the plunger.

An Old-Time Piston Valve.

Those who suppose the piston valve to be a comparatively new invention will be surprised to know that a balanced piston valve was in use as long ago as 1833, as stated in the following note contributed by C. E. Wolff in the "Mechanical Engineer." Advocates of the piston valve will also be glad to learn of the excellent record made by this one:

At Swannington, Eng., on the Midland Ry., between Burton and Leicester, there is an old winding engine used for drawing trucks up an incline on a colliery branch. This engine, set to work



in 1833, is still used once a week, and is chiefly remarkable for being fitted with a piston valve, of which we give an illustration. As will be seen, the valve is of an ordinary type, each end being fitted with two gun-metal rings, kept up to their work by a steel spring. During the sixty-five years the valve has been at work it has only twice been removed for examination. On both occasions it was found to be in perfectly good condition, and was replaced without being touched, and is still working with the original rings.

The shaft consists of a square forging left rough, except for

the journals, the flywheel being fixed on the square. There is no reversing gear, as the trucks run down the incline by gravity, drawing back the rope.

Altogether the engine is in as good condition as it ever was, and is a fine example of honest English work. Unfortunately I have been unable to discover the name of the maker, as there is no plate on the engine and no record appears to have been kept.

* * *

A NEW 10-INCH LATHE.

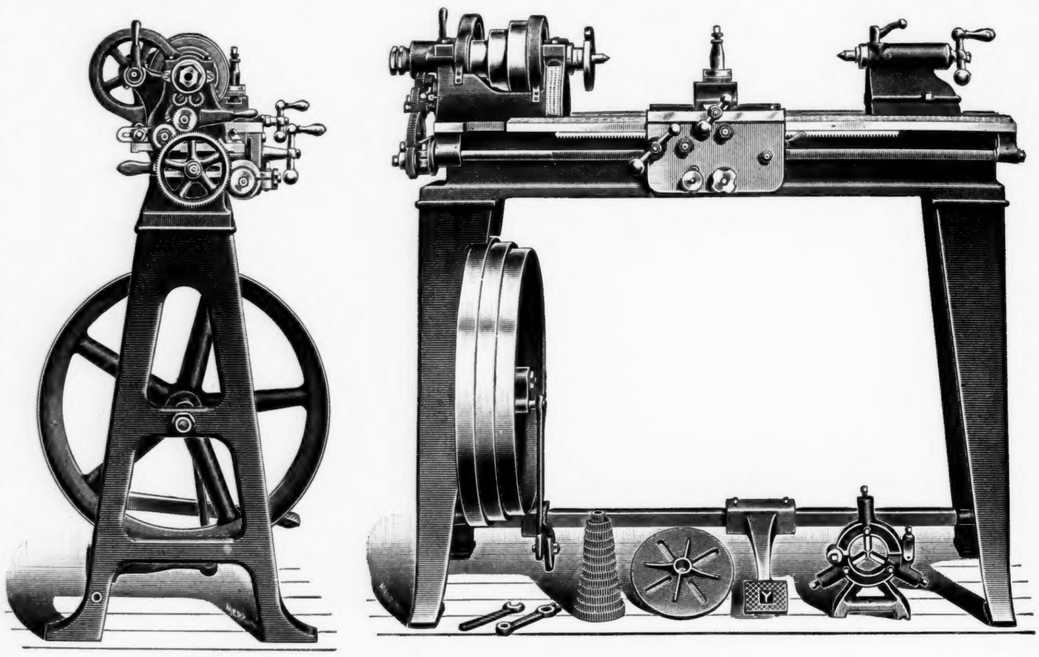
The accompanying illustrations show the front and end view of a 10-inch screw cutting lathe that has just been brought out by the W. C. Young Mfg. Co., Worcester, Mass. It is made from the designs of Mr. Young, and possesses features that will be appreciated by electricians and bicycle repairers and those who are engaged in experimental and laboratory work.

All the working parts are exceptionally heavy and are carefully fitted. The hollow head spindle is forged from 1 7-16-inch crucible steel and runs in heavy bronze boxes. The cone has three steps for 1½-inch belt and the back gear ratio is 8 to 1. This gives six speeds, which increase in geometrical progression. The lathe is furnished with plain rest and automatic cross-feed and the tool is adjusted by screw collars on the tool post. The compound rest is of entirely new design, and is to be furnished only as an extra attachment. The friction feeds have a range of from 32 to 110 to the inch.

Gears are furnished to cut a large range of threads, covering all machine screw threads from 5 to 72, including 11½ pipe thread. A special lead screw and gearing can also be furnished for cutting metric threads. The back and feed gears are covered to prevent injury to the hands or belt.

The lathe is built with an improved foot motion, which reduces friction to the minimum. A friction countershaft is furnished in place of the foot motion, if desired, at the same price. A rack is provided for holding the change gears, center rest and face plates when not in use. The jaws of the center rest are o hardened steel carefully finished.

The lathe, with 4-foot bed, weighs on skids, ready for shipment, 525 pounds.



A NEW LATHE.

* * *

FRESH FROM THE PRESS.

THERMODYNAMICS OF THE STEAM ENGINE AND OTHER HEAT ENGINES. By Cecil H. Peabody, Professor of Marine Engineering and Naval Architecture, Massachusetts Institute of Technology. Published by John Wiley and Sons, New York. Fourth Edition, rewritten and reset. 522 8vo pages. Price, $5.

This work was originally prepared to supply the need felt by its author for a thoroughly modern and comprehensive text-book for the use of his students in steam engineering. The present edition is a complete revision to bring it in accord with more recent practice and any changes have been made which it was believed would make it more useful as a text-book.

For the benefit of those who are not acquainted with the work, it may be said that the theory of thermodynamics is presented very fully, the treatment being rigidly mathematical, and applications of this theory are made in the chapters upon perfect gases, saturated and superheated vapors, the flow of fluids, the injector, the steam engine and in other parts of the work. A distinguishing characteristic, however, is the attention given to the results of actual tests. The fact is recognized that no mathematical theory, based on the adiabatic action of steam can be more than a rough and uncertain approximation of its actual performance when in contact with walls that absorb or give up heat with the greatest freedom. It has long been the custom to teach the strength of the materials by supplementing the theoretical work with a study of the results of laboratory tests to assist in the selection of constants and to determine wherein the conditions in practice are such as to cause a divergence from the theoretic conclusions. If there is need of using this method in the study of the strength of materials, there is much more need of its adoption in the study of thermodynamics; and the fact that this method has not always been used is in our opinion largely responsible for the discredit that practical men have cast upon a theoretical study of the steam engine.

Most of the matter relating to the results of tests is given in two chapters, one upon the action of the cylinder walls, and one upon the economy of steam engines. The first contains a full discussion of Hirn's analysis of the heat transfer in an engine cylinder, with results, and also of such other investigations as have been made to ascertain the effect of the cylinder walls upon the action of the steam. The second chapter includes the results of numerous engine tests accompanied by a comprehensive discussion and summary of results. Prof. Peabody has the reputation for relentlessly rejecting the results of any tests that do not bear the stamp of reliability, and we believe that in these chapters will be found the best presentation extant of the important subject of steam engine economy.

Attention is given to compressed air, refrigerating machines and hot air and gas engines. There are chapters on engine testing, engine friction and the theory and proportions of compound engines. Late subjects, like the Diesel motor and the steam turbine, receive notice, and throughout the work the results of tests are given where possible, this feature being noticeable even in the chapters on the flow of steam and the injector. The book is a resume of the latest research in steam engineering, and will be valued alike by the student and the mechanical engineer.

The Metric System of Weights and Measures. Published and for sale by The Hartford Steam Boiler Inspection and Insurance Co., Hartford, Conn. 196 pages, pocket size. Bound in leather, with red edges, $1.25; printed on bond paper, with still more substantial binding, $1.50.

A good work has been done in preparing this volume. It supplies a need that is felt by many for more complete conversion tables for English and metric units. A brief explanation of the metric system is given, and then follow the following tables: Centimeters and inches; meters and feet, meters and yards; kilometers and miles; square centimeters and square inches; square meters and square feet; square meters and square yards; square kilometers and square miles; hectares and acres; cubic centimeters and cubic inches; cubic meters and cubic feet; cubic meters and cubic yards; cubic miles and cubic kilometers. Then follow tables of fluid ounces, liquid and dry quarts, gallons, the British quart and gallon, bushels, the measures of weight, like grains, ounces and pounds, both Troy and Avoirdupois, tons, pounds per square foot, pounds per square inch, heat units, foot-pounds, horse-power, ounces in a cubic inch, pounds in a cubic foot, tons in a cubic yard, grains in a gallon and thermometer scales. In each case the conversion is first given from the metric to the English unit and then from the English to the metric, the units being carried to 100 in all of them. The tables were computed by A. D. Risteen, associate editor of the "Locomotive," who has had an extensive experience in the computing division of the U. S. Coast Survey. For use in the shop the book would be more convenient if there were a table of millimeters and inches, and one of fractional parts of a millimeter.

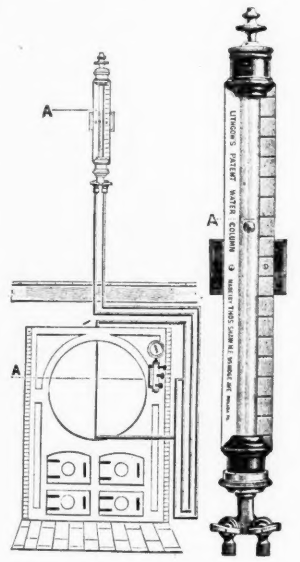
HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

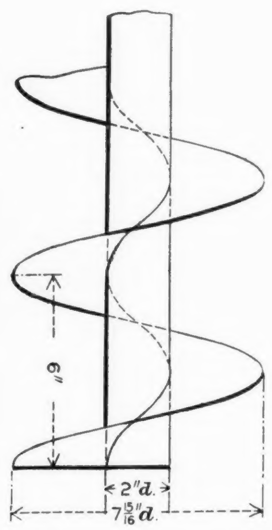
Give all details and name and address. The latter are for our own convenience and will not be published.

[This department was conducted by Mr. F. F. Hemenway up to the time of his death, and we believe it has been of great interest and value to all. Beginning with the February issue it will be taken charge of Mr. A. H. Eldredge, a frequent contributor to MACHINERY, and for the two months intervening—this month and next—Mr. Wm. Wallace Christie, a consulting engineer of this city, has kindly consented to prepare the answers.]

42. G. M. J. asks: (a) Will you explain in MACHINERY the principle and working of the planimeter; why does it read correctly, especially when it depends upon sliding motion? (b) Will you explain the principle and working of the Leithgow water gauge, cut of which is enclosed? (c) Find enclosed sketch of helix; please explain how to lay out on a flat sheet the pieces which, when cut, would bend into the proper shape for helix. A. (a) We will assume that you refer to the Coffin Planimeter, which is a special form of the Amsler. In this instrument the one end of the fixed arm travels in a right line—slot made for that purpose—which, by means of calculus, enables us to subtract two differential equations and derive one in which the area of the diagram is equal to the space registered by the recording wheel, multiplied by the length of the planimeter arm; or in symbols $A = l\,R$.



(b) LEITHGOW WATER GAUGE.



(c) SKETCH OF HELIX.

By placing the diagram correctly on the board furnished with the instrument—in fact a part of it—we may get the mean effective pressure by starting at the furthest point at the right and by passing around the diagram in a clockwise direction to point of beginning, then pass the tracing point vertically until the record wheel reads the same as at the starting point.. This distance between points measured by the scale of the spring used for the diagram will be the M. E. P. For

Let p = mean effective pressure.
Let A = area of diagram.
Let R = register of recording wheel.
Let L = length of diagram.
Let l = length of planimeter arm.
Let D = perpendicular distance.
$A = p\,L = l\,R$.

Let Q be the angle made by the arm with the guide; then, as in moving the point vertically, this angle will not change, the record will be $R = D \sin Q$.

When the point was at the end of the diagram $\sin Q = \frac{L}{l}$; therefore, $R = \frac{D\,L}{l}$ substituting in equation for A,

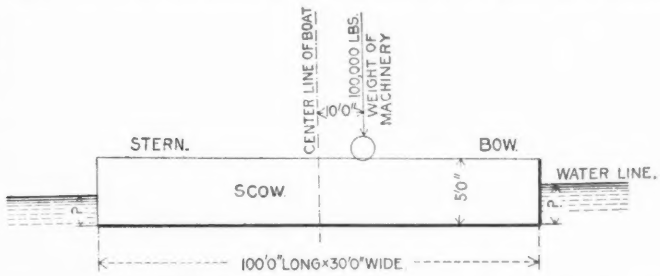
$$p\,L = l\,R = \frac{l\,D\,L}{l} = D\,L.$$

Dividing the first and last member of the equation by L, we have $p = D$.

(b) Inquiry from the makers fails to meet with a reply; from other sources we understand that the exact principle of working is a trade secret.

(c) The surface is undevelopable.

43. W. S. encloses a sketch of a scow loaded with machinery. The center of gravity of the machinery is 10 feet from the center of the boat. The total average displacement is about $2\frac{1}{2} \times 30 \times 100$ feet. He wants to know how to calculate the water line. A. The data given are insufficient for an intelligent reply.



The usual method for obtaining displacements, however, we understand, is by model, and after knowing the angle of inclination from the vertical the scow would take on being loaded, the exact water line may be calculated.

44. Pittsburg writes: Kindly let me know through your paper if there is any cheap solution that I could dip polished steel into to keep it from rusting, but at the same time not to blemish the finish. A. The only thing we can suggest is that after thorough cleansing the steel be dipped in or coated with raw linseed oil. This will require about a week to dry, during which time carefully protect the same from the weather. The surface will be somewhat gummy, so that it may not be just what you are looking for. Various preparations are made by the manufacturers of oils.

45. M. S. T. writes: (a) Please give the ingredients and proportions of same for an anti-friction metal that will expand more than cast iron when heat is applied. (b) Name an anti-friction metal suitable for metallic piston and valve rod packing. (c) What material is used in the best practice for crankshaft bearings for engines of 50 HP. and larger? (d) Give the name of a book containing reliable information, up to date, upon steam engine design, including flywheel and condensers. A. (a) As the coefficients of each of the ingredients of most anti-friction or bearing metal alloys is greater than that of cast iron, they will expand more than it when heated. Magnolia metal is said to have this composition by Pennsylvania R. R. chemists: Copper, trace; lead, 83.55 per cent.; zinc, trace; Antimony, 16.45; iron, trace; bismuth, possibly trace. Dr. H. C. Torrey, however, asserts that it always contains tin.

(b) Robert Grimshaw says in "The Steam Engine Catechism": "A piston rod packing must allow the rod to move freely up, down or sidewise with little friction, with little wear of the rod or of the packing, and must make a steam-tight joint under the highest pressure that will be found in the cylinder." This is well stated, and in locomotive work, Babbitt metal rings are sometimes used as well as brass rings with an intermediate metal ring, composition: Tin, 80 parts; antimony, 10 parts; copper, 1 part. The latter have given the best of satisfaction on both piston and valve rods.

(c) Cast iron boxes, lined with Babbitt metal.

(d) "Steam Engine Design," by Jay M. Whitham.

You will find considerable of value in Kent's "Mechanical Engineer's Pocket Book."

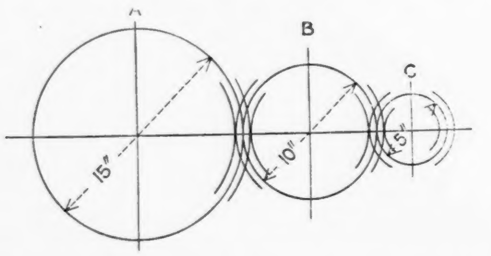
46. E. F. S. writes: I am building a 1-HP. gasoline engine, and have difficulty in fitting my piston rings perfectly. Will you kindly inform me of the proper method in fitting them. Would it be practical to grind them in the cylinder? Diameter of cylinder $3\frac{1}{2}$ inches. A. Turn the rings from 1-32 to 1-16 of an inch

larger than the cylinder, depending upon the stiffness of the rings, and after cutting one side in two in the usual manner, spring into the cylinder. Your judgment will have to dictate what to allow over the diameter of the cylinder. The rings must be tight enough to prevent leakage, and not so tight as to cut the cylinder or to absorb too much of the power of the engine. It is entirely feasible to grind in the rings, using powdered glass for the purpose, but this ought not to be necessary. It is not to be expected that they will be tight at the start, but they will seat themselves in short time.

47. C. W. S. asks: (a) What is the probable limit of speed that could be obtained in firing a charge of gas in a cylinder? Mixture being compressed in separate cylinder, and not taking into consideration wear and tear of engine.

(b) What is the proper proportion of cylinder to compression space? A. Your question is not very clear. Send us more details, and we will endeavor to answer it in full. We suggest, however, that you get Hiscox book on gas engines; also Dugald Clerk on "The Gas Engine." They may help you get at just what you want and more.

48. G. D. asks: Will you explain some simple method of figuring the feed of a lathe or screw machine ! A. If wheel C makes 500 turns in a minute geared to B, B will make as many revolu-



tions as the ratio of 5 to 10 times 500, or 250 turns; now, if B in turn is geared to A, A will make as many revolutions as the ratio of 10 to 15 times 250, or 166 2-3 turns.

The above might be expressed at once by proportion, thus: $\frac{5}{10} \times \frac{10}{15} = \frac{50}{150}$ or 1-3, in which the driving diameters are the enumerators and the driven diameters the denominators. Now, suppose A was the driving wheel, making 500 turns, then by proportion $\frac{15}{10} \times \frac{10}{5} = \frac{150}{50} = 3$, or C would turn three times as fast as A, or 1,500 turns per minute. The numbers of geared wheels could be increased to any number, and the same method should be followed out; if the gears are all of equal pitch—that is, centers of adjacent teeth—you can substitute the number of teeth in the above for the diameter of pitch circles.

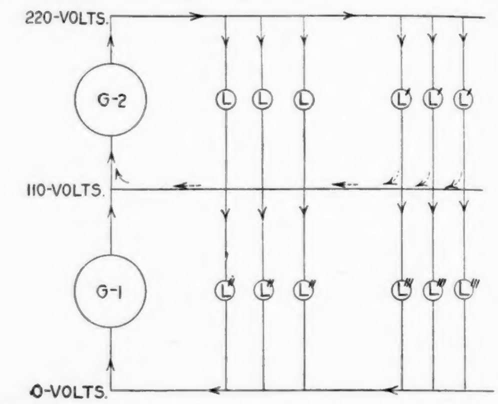
We will be pleased to answer any other question of gearing that you may wish to ask.

[The two following are replied to by Wm. Baxter, Jr.]

49. H. J. L. writes: The field coils and the rheostat of our motor get very hot, even when the load is light. The line wires only run about sixty feet. Would it be any benefit to reduce the size of these line wires, so as to increase the resistance? A.—Although the machine in this inquiry is called a motor, the action explained leads us to believe that it may possibly be a dynamo. If the armature of a dynamo, or a motor becomes too hot, it is because the machine is overloaded. If the field coils and the rheostat of a dynamo become too hot, it is because the machine is run at too high velocity. The remedy in this case is to reduce the speed or to put more resistance in the field circuit, but both remedies will cause a reduction of the voltage. To maintain the same voltage, and reduce the heating of the field, the remedy is to wind more wire upon the field; this to be of the same size as that already on it. If the machine is of standard make, i. e., not experimental, it is evident that the field winding is proper, and the trouble is due to too high a speed.

If the machine is a motor, the starting rheostat will get hot if left in circuit more than fifteen or twenty seconds, which is the time generally required to get the armature up to full speed. If the field coils get too hot, it is because the voltage of the current is too high. Making the line wires smaller, so as to increase the resistance, will remedy the trouble, slightly. To produce a noticeable effect the resistance of the wires must be increased forty or fifty times. This remedy, however, is not a good one, as it will cause the motor to run much slower when the load is increased. The proper remedy is to put resistance in the field circuit, but this will make the motor run faster.

50. F. A. N. asks: Will you please explain through the columns of your paper the three-wire system of electric wiring for incandescent lighting, Also how to make the connections with the dynamo. A.—The object of the three-wire system is to reduce the amount of copper required for transmiting the current necessary to operate a certain number of lamps. It accomplishes this result by increasing the voltage of the line current without increasing the voltage supplied to each individual lamp. The accompanying diagram illustrates the principles of



the three-wire system. G^1 and G^2 are two generators connected in series. The three wires lead off as shown. The voltage between the outside wires is 220, but from either side to the center it is only 110. The lamps are connected as shown. If the number on both sides of the center line is the same, the current will flow from the top line, through the two lamps in each wire, and return to the generators through the lower wire, as is indicated by the arrow heads on the lines. If the three L lamps are disconnected, the current passing through the lamps L^1 will return to the generators through the center wire, as shown by the dotted arrows. It can be readily seen that this must be the case, for the current passing from the top wire to the center one is sufficient for six lamps, while that from the center wire to the bottom is only enough for three lamps, hence the difference between these two currents must find its way back to the generators through the center wire. If there wer more lamps between the center and the lower wire the result would be the same, with the exception that the extra current would flow through the lower generator G^1. When the number of lamps on both sides of the center wire is the same, the system is balanced, and no current flows back to the generators through the center wire. When there are more lamps on one side of the center than the other, the system is unbalanced and the excess of current on one side will return to the generators through the center wire.

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FRESH FROM THE PRESS.

THE DESIGNING OF CONE PULLEYS. By Walter K. Palmer, M. E., School of Engineering, University of Kansas. For sale by the author. Price, 50 cents.

Mr. Palmer has published in pamphlet form a discussion of the cone pulley problem, in which he has considered the various methods suggested by different authors, and has finally extended and added to that of Prof. Releaux's, until he has developed a diagram which can be easily constructed for any particular case, and that will give exact results. Instead of depending upon a fixed diagram to which reference must be made whenever it is desired to design a cone pulley, Mr. Palmer uses a diagram, the construction of which can be easily remembered, and that can be quickly drawn for any case that arises. While much of the pamphlet is devoted to a mathematical discussion of the problem, the final results are brought into such shape that they can be understood and applied by any person whose mathematical training has not been sufficient to follw the earlier part of the work. Another paper by Mr. Palmer has been sent us upon the properties and use of the hyperbolic spiral. The final application of the results is made in the design of a universal irregular curve, which has been found by actual use to be suited to nearly all irregular curves, both large and small, that the draftsman has to make. This is owing to the fact that the instrument possesses a wide range of curvature varying from

nearly a straight line to a small and almost perfect circular curve.

THE PENCOYD IRON WORKS, Philadelphia, Pa. Steel in Construction. Convenient Rules, Formulae and Tables for the Strength of Steel Shapes used as Beams, Struts, Shafts, etc. 350 pages, pocket book size, bound in leather.

This pocket book is too well known to need an extended notice. The tenth edition has just been issued, for which the contents have been thoroughly revised, and much new matter has been added. The greater part of the work is devoted to tables of the strength, deflection, safe loads, etc., of the Pencoyd beams. A large amount of other material is included, such as stresses in frame structures,moments of inertia, areas of circles increasing by eighths, tables of reciprocals and the trigonometrical functions, and various other rules that occur frequently in engineering practice. The book is a standard one for the use of engineers, and is indispensable to those who are engaged in any form of structural work. It is the most handsomely bound pocket book that we have seen; the type used both for the tables and the text is unusually clear, and the book is carefully printed on good paper. The tables were prepared under the supervision of Mr. James Christie, and the book as a whole is highly creditable to the firm issuing it..

ADVERTISING LITERATURE.

THE STANDARD SIZES FOR CATALOGS ARE 9 x 12, 6 x 9 AND 3½ x 6 INCHES. THE 6 x 9 IS RECOMMENDED, AS THIS SIZE IS MOST LIKELY TO BE PRESERVED.

THE AMERICAN STOKER CO., Washington Life Building, New York. Illustrated catalogue of the American Stoker and Its Application. 65 pages, 6 x 9 standard.

This catalogue is illustrated with many views showing the construction and application of this stoker to boilers of different types. There are also reproductions of photographs of plants where the stoker has been installed and descriptive matter setting forth the advantages and giving tests showing the efficiency of the stoker.

THE LANDIS TOOL CO., Waynesboro, Pa., have issued a treatise on the construction and use of their grinding machine for grinding cylindrical, conical and plain surfaces. It is of standard 6 x 9 size, contains 98 pages and is handsomely illustrated. Various views of their machines are given with many details showing their construction and the methods of doing work of various descriptions. Much practical information is included about the use of grinding machines, and the book will prove a valuable one to all interested in this class of work.

THE UTICA DROP FORGE AND TOOL CO., 20 Warren street, New York, have sent us a catalogue, illustrating the products of several firms, of which they are one. Their department includes various styles of pliers and nippers, some of which are of new design that will prove interesting to mechanics who are in search of small tools.

GUSTAVE HANARTE, Mining Engineer, Mons, Belgium, has favored us with an illustrated circular of his patent mining machinery, and also with a pamphlet containing a paper upon "The Transmission of Power by Compressed Air,"read by Mr.Hanarte before the Society of Engineers of Hainaut. Those who wish to carry their investigations into foreign publications will doubtless find this pamphlet of interest and value.

THE CRESCENT STEEL CO., Pittsburg, Pa., have issued a pamphlet upon steel making, illustrated by photographs of their works and containing interesting descriptive matter regarding the production of steel and the uses to which it is put. This pamphlet is one of the most artistic productions in the line of trade literature that we have seen.

NOTES ON THE TROPENAS STEEL PROCESS is the subject of a paper that was read before the American Foundrymen's Convention last June, and which has now been published in pamphlet form by Powell & Colne, 11 Broadway, New York, sole agents in the United States for the Tropenas process. The Tropenas system of steel castings is said to compare favorably with the Siemens-Martin process, and the results to be equal to those of the best crucible steel.

E. W. BLISS COMPANY, Borough of Brooklyn, N. Y. Pamphlet of 70 pages, 9 x 12, standard size.

This pamphlet contains a series of large illustrations made from photographs of various departments of the Bliss Works, showing the work in actual process of construction and including views of the torpedo room, where a large amount of material is made for the government. The book also contains illustrations of the leading machines made by this company, and a number of advertisements of different firms in other lines of work.

THE MCCONWAY & TORLEY COMPANY, Pittsburg, Pa. Catechism of the Master Car Builders' Rules, 40 pages, pocket size, bound in leather.

While this book is primarily an advertisement, it is believed that it will be of practical value to car inspectors and many others who are engaged in railroading or the design and construction of cars. A copy will be sent free upon application.

THE WILLIAMS PATENT CRUSHER & PULVERIZER CO., St. Louis, Mo., have issued a small catalogue devoted to their hinged hammer crushers and pulverizers, that will be of interest to those engaged in the various milling and grinding operations, or in chemical work.

LIDGERWOOD MANUFACTURING CO., 96 Liberty st., New York, Catalogue of hoisting engines and boilers, suspension cableways, log hauling machinery, conveying apparatus, etc. 140 pages, illustrated. Size, 9½ x 11¾.

The improved apparatus made by this company is fully described and illustrated and practical information regarding its operation is included. There are tables of sizes and specifications covering the parts of the various machines, which will enable the prospective buyer to form an intelligent opinion as to the capabilities of the apparatus.

THE B. F. STURTEVANT CO., Boston, Mass., will send upon application a reprint from "Cassier's Magazine" of a lecture delivered by Walter B. Snow, of the engineering staff of this company before the students of Cornell University. The subject is mechanical draft.

MANUFACTURERS' NOTES.

GOULD & EBERHARDT, Newark, N. J., report business as excellent, and state that they are shipping a large number of tools to the various arsenals and navy yards of the government.

THE LYNN INCANDESCENT LAMP CO., Lynn, Mass., call attention to the fact that they make a specialty of renewing the films in incandescent lamps, and that by sending the old lamps which have been burned out to them for renewal a substantial saving can be effected.

JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J., have added a large extension to their pencil factory, in which the machinery is driven by electrical power. During the coming year other extensive additions are contemplated. As their dealings are with firms making a great variety of articles in different lines of trade, they consider that their continued good business is a hopeful indication of the condition of trade throughout the country.

A MAGNETIC LAMP.

Every mechanic knows the difficulty of doing machine work during the winter afternoons when a light is necessary, and the introduction of the electric light seems to have increased rather than diminished this trouble. It was possible to place the old gas jet where it was wanted, and fairly good results could be obtained from it; but it is not so easy to hold the swinging incandescent lamp in a convenient position. To overcome this difficulty Jenkins Bros., 71 John street, New York, have placed on the market a magnetic lamp holder for use with the direct current system, and which can be attached to any style of lamp. Being a magnet, it will adhere to any piece of iron or steel in any position. In the machine shop this device will be found specially useful in boring operations where the lamp can be attached directly to the lathe carriage and will advance with the tool.

THE AIR-BRAKE SITUATION.

The Westinghouse Air-Brake Co. authorize the following statement in regard to the New York and Boyden companies:

The purchase by the Westinghouse Air-Brake Co. of the patents and business of the Boyden Brake Co. is the final conclusion of a long and interesting litigation relating to air-brakes. The course of these suits has been followed with interest by railroad men, because to a considerable extent they involved the right of the Westinghouse people to the sole manufacture of what is known as the "Quick Action" brake. By the purchase of the Boyden inventions, which the Supreme Court said were highly meritorious, the Westinghouse Co. still claims to control the situation, although this is contested in the United States Courts by the New York Air-Brake Co. The Westinghouse Co. have been successful in compelling the New York Co. to cease making three different forms of brakes, and they claim that a fourth one, which they are now putting on the market, is also an infringement of their patents. This question will be finally determined by the Court of Appeals, probably in November or December, the opinion of the lower court having been favorable to the New York Co. Should the decision be favorable to Westinghouse, then the New York Co. will once more be enjoined and prevented from making their present style of brakes.

In addition to this particular suit, it appears that the Westinghouse people have brought three other suits against the New York Co., and it would therefore look as if litigation between these two concerns was to be, if anything, more protracted than that between the Boyden and Westinghouse companies.